EDITORIAL

Prices and Profits

ONE of the effects of price reductions is to decrease wholesalers' and retailers' margins of gross profit measured in dollars unless, of course, a compensating increase in discount is made. Because of this fact, the recent price cuts in our own industry have occasioned some dissatisfaction in the trade and similar complaints have been heard from time to time since the fall of 1920, when prices first started to trend downward after the post-war deflation period.

With lower prices prevailing and discounts having increased only slightly in five years, it becomes necessary to sell more cars to earn the same annual gross profit in dollars and, if net profits are not to suffer, selling costs per car must go down.

Economists agree that the present downward trend of general commodity prices will continue for some time to come and the automobile is not likely to prove an exception, although car prices probably will not suffer as much in the future as other commodities, due to the large cuts that have been made already by our industry.

In view of this trend, it is important for the trade to do some straight thinking on the effect of falling prices on net profits and their relation to gross sales and capital investment.

Of course, a slight increase in the dealer discount rate would have an important effect on profits, provided it was not absorbed by used car losses. For the present, however, the trade must look for relief from present conditions from the following sources:

1. More intensive cultivation of the territory to find the prospects who will buy the larger number of cars.

2. More careful scrutiny of disbursements for direct and overhead expense. The use of budgetary control offers much promise in this connection.

3. Continuance of the policy of keeping production more closely in step with retail sales.

American Makers in Britain

DESPITE the campaign waged by British manufacturers to get the English people to buy British cars and shun those built by American makers, it begins to look as though profits from a large proportion of the cars sold to British subjects will continue to come into the pockets of American concerns, either directly or indirectly.

The extent of American-controlled manufacturing or assembly plants in Great Britain has increased constantly for several years. Ford, Overland and General Motors all control manufacturing or assembly facilities there at the present time and evidence of the interest that American builders are taking in acquiring additional facilities is furnished by the negotiations of General Motors for the purchase of the Austin Company. This deal has apparently fallen through, for the present at least, but on its heels comes the rumor that three other important British concerns may come under American control within the next few months. The name of Morris-Cowley, the only British quantity producer, is linked with one of the merger negotiation rumors. Should this company come under American control, and two other British companies become subject to American domination as well, our industry would profit directly from the sales of a very large percentage of the motor vehicles manufactured or assembled in the British Isles.

Just the Other Way Around!

A FEW days ago The New York Sun made editorial outcry upon learning that a new bus line between New York and Philadelphia charges less for passage than the railroad fare. "The buses," said The Sun, "will pay no real estate tax, evade a fair share of the cost of highway maintenance. . . The railroads, beside running over private rights of way, pay taxes to support municipal and State owned utilities. Under present conditions the bus owner is the spoiled child of American transportation."

In 1924 the automotive industry paid $555,026,548 in taxes. During the same year the railroads with their much greater investment in taxable real estate, stations, right of ways, etc., paid $350,000,000. The automotive industry paid 33 1/3 per cent more taxes than the steam and electric railroads combined. The railroads' ownership of taxable property does not appear to be a fair indication of the relative amount of taxes paid.

During 1924 approximately $209,000,000 was spent for highway maintenance. Motor vehicle owners, through direct taxation, paid this entire bill and contributed about $350,000,000 or 45 per cent of the $782,000,000 spent for new highway construction during this period. In addition to this sum, they contributed as members of the community to highway expenses. In the light of these facts the statement that they "evade a fair share of the cost of highway maintenance" seems a bit absurd.

Rather the shoe seems to be on the other foot and the automotive industry has a better right to complain of the tax distribution methods used, since in only 14 States are motor vehicle receipts applicable in total to highway expenditures. In the 35 States having gasoline taxes only about 58 per cent of the receipts are available for highway purposes. The remainder goes to general funds for use, partially in supporting State and municipal owned utilities.

Our Industry Today

Deferred Demand, Due to Awaiting Appearance of New Models, Expected to Lead to September Records, After High Summer Level

NEW YORK, Sept. 16—New production records are likely to be made this month by some of the automobile companies that introduced new models toward the end of the summer. These producers are now feeling the full effect of the deferred demand for their products from buyers who were awaiting the appearance of the new cars. All the factories, however, are benefiting from the normal upturn in sales during the early fall, which is being felt with particular force this year, since demand held during the summer at an unusually high level.

When the Ford company attains full volume production on its new models, the production rate for the industry as a whole will be far ahead of any previous record for the season. This is unmistakably an "automobile year," and the generally prosperous state of industry coupled with sound agricultural conditions must be credited as the source of the demand for cars and trucks.

Good Parts Business Ahead

Forecasts made by representative parts makers indicate a continuation of good sales through the fourth quarter of the year. There will undoubtedly be recessions, but the level should be well above that of the corresponding period last year. Prospects for parts business are an excellent index of future conditions for the entire industry.

Interest is being focussed on small cars of the European model, with shorter wheelbases and lower horsepower than any of the American makes. Cars of this type will be placed on sale abroad by several of the American producers, thus affording direct competition with the factories overseas. But beyond that, it is known that attempts will be made to popularize the small cars in the domestic market. There is an initial prejudice to overcome, but many believe that traffic congestion in the centers of population, aside from motives of economy, will lead to the adoption of cars that can be parked and operated in small areas. Taxicabs will probably be the first to be brought out, and these may afford the entering wedge for general use.

Prosser with GMAC

NEW YORK, Sept. 15—At a meeting of the board of directors of General Motors Acceptance Corporation, held Sept. 14, Seward Prosser was elected to membership on the board. Mr. Prosser is chairman of the board of directors of the Bankers Trust Co., New York. He has been a director and member of the finance committee of General Motors Corporation for some years, and has followed very closely the progress of the General Motors Acceptance Corporation.

Lighting Problems Discussed by A.E.A.

Electrical Equipment and Distribution Taken Up at Annual Meeting

EAGLESMERE, PENN., Sept. 17—Motor coach electrical equipment, head lighting, and parts distribution were among the major topics discussed at the Ninth Annual Convention of the Automotive Electric Association, which closed here today. The elimination of the dash ammeter and the use in its place on motor coaches having a voltage regulator of either a voltmeter or a charge-off-discharge indicator was recommended.

The reason for this change is that, with voltage control, the reading shown by the ammeter is often so small that the operator thinks the battery is not receiving sufficient charge, and he alters the adjustment of the regulator, with consequent overcharging and damage to the battery. With a regulator the charging rate is automatically taken care of and either a voltmeter or a charge indicator gives sufficient indication that the system is functioning properly.

Lighting of Buses

In connection with the interior lighting of buses, a subcommittee was appointed to study the proper location of lights and reflector equipment to give passengers sufficient illumination for reading and also to light the advertisements. The standard specification covering the 300-watt bus generator was changed to permit a maximum outside diameter of 6⅝ instead of 6½ inches. In explanation of the change in the generator standard, it was stated that the rating was at 1200 r.p.m. and that the units would give a greater output at higher speeds, which would meet the requirements of Summer and Winter bus operation.

A recommended practice was adopted to the effect that provision be made so that the driver can conveniently change the charging rate within certain limits. This control device will be in the form of a small lever which can be thrown into either the Summer or the Winter position.

Changes in gnition Equipment

Minor changes were made in the specifications covering standard ignition test equipment and procedure.

In the discussion following, the paper on "Headlighting," presented by Willard C. Brown of the National Lamp Works, a resolution was adopted directing the preparation of a booklet on the adjustment of headlights and the equipment required for this service. This booklet will be mailed to all electrical service stations in the country. The subject of parts distribution through authorized electrical service stations came in for much spirited discussion and the Association plans to study this subject with a view to increasing sales through these outlets.

White Motor Resumes Operations at Capacity

CLEVELAND, Sept. 16—The White Motor Co. plant has resumed activities on a capacity schedule, following a two weeks' shut down of production, during which the plant facilities were rearranged in order to speed up operations. Orders accumulated during the period of cessation and these were supplemented on the first two business days of the first week in September by numerous additional orders.

The manufacture of buses is becoming an increasingly important part of the company's business. One fourth of the electric railway lines are using buses. Out of a total of 3500 buses in use, the White Co. has supplied about 1200. The company's export business is showing marked expansion, shipments of trucks and buses being particularly heavy to Australia.

Changes at the factory that were made during the two weeks' shutdown include the re-locating of 400 machines and the installation of material conveyors and assembly tracks. New tools designed for more continuous and uniform production were tried out and better storage facilities were arranged for both raw and finished products.

FEDERAL ADDS TRUCK

DETROIT, Sept. 17.—The Federal Motor Truck company has just announced the addition of a Knight sleeve valve engined 1½ to 2 ton truck to its line. This model is to sell at about $1,650, or at about $500 less than the model S-23, which covered the 1½ to 2 ton field formerly for the Federal company.

Human Factor Holds Interest of S.A.E.

Personnel, Tool Problems, and Gears Discussed at Production Meeting

CLEVELAND, Sept. 17—Better understanding of the human element and training of men in various phases of automotive work is necessary to further increases in production efficiency. That was one of the chief ideas brought out at the annual Production Meeting of the Society of Automotive Engineers, held here Sept. 14-16. Mutual interchange of troubles and problems between automotive manufacturers and machine tool men, evidence of considerable interest in gear grinding, announcement by Col. H. W. Alden that Timken Axle Co. is working on an entirely new type of gearing, and discussion of inspection methods and machine tool safety were other outstanding features of the meeting.

Attendance at the S. A. E. gathering totalled over 300. The large machine tool exhibit held in connection with exhibition staged by the American Society for Steel Treating convention attracted many of the automotive engineers. The A. S. S. T. annual meeting was held here beginning Sept. 14. The two societies cooperated in various social events.

Talks on Personnel

Emphasizing quality as the paramount objective of production, and quantity and low cost as other prime considerations, K. T. Keller, general manager, General Motors of Canada, Ltd., told the S. A. E. men at the annual Production Dinner on Tuesday evening, that, after all, efficient production from every standpoint gets back to proper handling of personnel. Another phase of this same idea was developed at the session on foreman training in which Louis Ruthenburg, general manager, Yellow Sleeve Valve Engine Co., disputed the contention of F. T. Jones, White Motor Co., that foreman training can best be handled by bringing in some outside agency to conduct such activities. Mrs. Lillian Gilbreth, talking on training of workers, outlined the relative merits of the training school kept separate from the factory proper and the one made a part of the regular production work.

Discuss Gear Problems

Col. H. W. Alden, Timken Axle Co. stated his belief that the present basis of gear tooth forms is all wrong and said that his organization now has some new developments in progress. Cyanide treated steel and grinding of gears were discussed by P. L. Tenny, Muncie Products Div., General Motors Corp., while Earl Buckingham, Niles-Bement-Pond Co., said that lack of accurate means for gear measurement which can be used as quantity production equipment is one of the chief difficulties in gear manufacture today.

R. M. Hidey, White Motor Co., and W. G. Cariens, Ajax Motors Co., gave the car builders' side of the machine tool problems, while A. C. Cook of Warner and Swasey and E. F. Du Brul, general manager, National Machine Tool Builders' Association and others showed how the vehicle makers can get better results from further cooperation with the machine tool industry.

Other speakers included G. F. Keyes, Mullin Body Corp.; R. I. Mowery, Studebaker Corp.; R. M. Anderson, Holley Carbureter Co.; A. R. Kelso, Continental Motors Corp.; J. G. Moohl, Cleveland Automobile Co.; R. F. Thalner, Buick Motor Co.; C. J. Ross, Buick Motor Co., and J. J. Feely, Glenn Martin Co.

Slight Output Drop Reported in Tires

NEW YORK, Sept. 17—The monthly statistical bulletin of the Rubber Association of America, Inc., shows that while inventories of high pressure inner tubes declined in July from the June figures, production increased. Balloon inner tube production and inventories both fell off.

Inner tube inventories fell from 5,910,609 in June to 4,677,647 in July, and production gained from 3,566,099 to 4,297,495. July balloon inner tube inventories were 1,798,919, against 1,896,178 for June, while production dropped from 1,640,465 to 1,360,719.

Inventories of high pressure pneumatic cord casings decreased from 2,870,827 to 2,502,055, production gaining from 1,894,704 to 2,181,645. Balloon casing production fell from 1,729,121 in June to 1,561,806 in July, inventories increasing from 1,527,629 to 1,654,629. Fabric pneumatic casing inventories showed a sharp decline from 1,033,840 to 658,814, and production gained from 439,397 to 447,145.

Report Ford Seeks to Acquire Textile Mill

CHARLOTTE, N. C., Sept. 17—Impending invasion of the textile manufacturing industry of the South by Henry Ford is seen by leading textile figures here in reports that Ford is negotiating for the purchase of the Loray Mill at Gastonia, valued at from $6,000,000 to $7,000,000. Confirmation of the report is lacking, and executives of the mill, a unit of the Manville-Jenckes chain, decline to discuss it, but do not deny that negotiations are in progress.

It was reported the Manville-Jenckes Corporation of Pawtucket, R. I., set $7,000,000 as the value of the plant, which manufactures fabric used in the manufacture of automobile tires.

STAR SALES INCREASE

NEW YORK, Sept. 17—Colin Campbell, vice-president of Durant Motors, Inc., states that factory sales of Star cars in August increased 161 per cent over August, 1924.

A.S.S.T. in Annual Convention in Ohio

Record Attendance and Great Exhibit Feature Meeting—Officers Nominated

CLEVELAND, Sept. 17—The Seventh Annual Convention of the American Society for Steel Treating in session here this week has a record-breaking attendance and great interest has been displayed both in the technical sessions and in the exhibition of steel treating and machine tool equipment being held in the Public Auditorium.

On the opening day registrations totaled more than 1700. Technical sessions started Monday with about 400 in attendance, and this display of interest in the discussions continued throughout the meeting. For the first time, papers and discussions were limited in time, and widespread approval was expressed of the change, which tended to make each session more lively and interesting.

Officers for 1926

Nominations for officers for 1926 were made Monday and included: R. M. Bird, Bethlehem Steel Co., president; J. Fletcher Harper, Allis-Chalmers Mfg. Co., vice-president, and Zay Jeffries, Aluminum Co. of America, treasurer. New directors are H. J. Bornstein, Deere and Co., and R. G. Guthrie, Peoples' Gas Light and Coke Co., Chicago.

The exhibition is one of the largest ever held. All of the available 45,000 sq. ft. of floor space in the Public Auditorium is filled, and sixty-nine manufacturers were unable to obtain space. It is estimated that there is more than $2,000,000 worth of equipment on display. There are 450 machine tools on display; twenty manufacturers of electric furnaces have their equipment in operation and more than 500 grades of tool steel, and about the same number of other kinds of steel, are included in the exhibits. An exhibition official estimates that machine tool equipment represents one-quarter of the show, steel treating another quarter, steel itself a third quarter and inspection devices the final fourth. Society members and visitors by thousands have attended.

German Visitors to Detroit

DETROIT, Sept. 15—Headed by Felix F. Alberti, consulting engineer of Berlin, a group of German manufacturers visited the different automobile plants in Detroit recently as the guests of the Automobile Club of America. Those in the party were: Ernest Neuberg, director general of the Automobile Construction Company; Herr Wuschak, general manager of the bicycle works at Madgeburg; Herr Schoendorf, head of the Karstadt, A. G., a department store group in Germany.

Tire Production in Some Quarters Less

No Radical Cut Anticipated—Outlook for Fall Business Is Bright

AKRON, Sept. 16—Tire manufacturers here were surprised at the sudden uprush in the crude rubber market last week. After selling at 79 cents a pound Wednesday, Sept. 9, rubber advanced 5 cents the next day, and in the ensuing two days extended the gain 11 cents more to 95 cents. Prior to this the market had showed signs of becoming stabilized around the 75 cent level.

One theory is that tire production has not been curtailed as fast as had been predicted by some rubber dealers, following the big summer buying rush. This had been relied upon drastically to reduce consumption of rubber in this country, and allow depleted stocks to be replenished in London.

Another factor which helped to bolster quotations, according to brokers, was that one vessel from Singapore with a large rubber cargo was delayed, and probably will not arrive until the last of the month.

Tire Production Curtailment

A canvass of the different factories in the Akron district shows that tire production has been curtailed in some quarters from 5 to 30 per cent under what it was a month ago. Some factories, including Goodyear, Goodrich, Firestone and Miller, are still running close to capacity, but the general opinion is that these plants will slow down somewhat by Oct. 1. A slight curtailment undoubtedly would be justified, in view of the slackening in sales in the last few weeks. No radical cut in production, however, is anticipated in any quarter. When conditions settle down, and the factories have had the opportunity of regulating their stocks and supplying their branches, many of which are even now demanding shipments due on back orders, it is believed that there will be a general reduction of about 20 per cent.

Outlook Optimistic

Optimism is noted in all quarters. Dealers' business is expected to be good during the fall months, and the outlook for manufacturers is felt to be exceptionally bright for some time to come.

It seems hardly possible that consumption of rubber should continue to exceed production much longer, although the expansion in the motor industry is helping to prolong this situation. The nearest relief in prospect is another 10 per cent release in shipments Nov. 1 under the Stevenson Act, which will bring shipments up to 85 per cent of production.

Actual consumption of rubber will not be in excess of production by the end of the year, according to one source of information, but now that stocks have been reduced to such an absurdly low level, production may exceed consumption for some months without affecting the position to any great extent.

Price Below Pre-War Average

Although much complaint has been registered at the big rise in the rubber market this year, it is pointed out in some quarters that the present price is still below the pre-war average, and that the average price for the last few years has been little more than the bare cost of growing. In view of this, it is stated present prices do not appear unreasonable, it being only fair that the rubber-growing industry should receive some compensation for the lean years in the past, when the raw commodity was selling at a loss to the producer, but which must have been advantageous to the manufacturer and ultimate consumer. It is only at high prices and a fair prospect of them being maintained, it is claimed, that producers are encouraged to enlarge their plantations, and capitalists are encouraged to invest fresh money in developing new areas.

Coolidge Asked to Aid Air Mail Plans

WASHINGTON, Sept. 17—The sympathetic support of President Coolidge for air mail service throughout the United States was sought here this week by Howard E. Coffin, president, and Col. Paul Henderson, general manager of the National Air Transport Corporation, which will seek a contract to operate an air mail line between Dallas and New York via Chicago.

Postmaster General New has announced that this contract would be opened for bids about Sept. 20 and Coffin stated his company would be a bidder. He said that he sought to extend the service of his company generally, if successful in getting the Government contract.

Discussing the development of aviation, Coffin said there are two essentials: First, that "we as a nation must, of necessity, for reasons both economic and in the interests of our National defense, formulate without delay a definite, continuing, comprehensive policy for the effective encouragement of American aviation"; second, that "commercial aviation must be made the background of any National plan for air policy looking toward strengthening of our National defense and must therefore be actively encouraged."

MOTOR PLANT PURCHASED

SHEBOYGAN, WIS., Sept. 16—Purchase of the plant of the Falls Motor Corp. at Sheboygan Falls, Wis., by the Jenkins Machine Co. of Sheboygan has been announced. The new owner will begin full operations in the recently purchased plant by Feb. 1, 1926, and the old plant will be sold.

McLaughlin Expects Record Production

Says General Motors of Canada Will Shatter Record This Year

TORONTO, Sept. 16—R. S. McLaughlin, president of General Motors of Canada, Ltd., speaking at a banquet held at the convention of dealers and distributors of Ontario and eastern Canada, stated that his company would shatter its production record this year by building 50,000 cars.

At the same meeting, C. F. Kettering, president of the General Motors Research Corp., and K. T. Keller, general manager of General Motors of Canada, Ltd., delivered addresses that were listened to with more than usual attention. The latter anticipates an accelerated selling of made-in-Canada motor cars shortly because of the reimposition of the McKenna preference duties. Mr. Keller said that Canada was planning to resume export to the United Kingdom upon a broad scale.

"Domestic sales of General Motors' cars this year are the largest in the company's history," said Mr. Keller. "In the quarter just ended, each month established a new high record of production, and sales' booking for summer and fall trade is the greatest we have ever had.

"Export demand for Canadian-built General Motors' cars is improving throughout the world. Some of the McLaughlin-Buick models will be handled exclusively from Canada this year. The general character of the product from Oshawa, Canada, stands high in foreign countries."

Following the resumption of the McKenna duties, E. R. Reilley, managing director of General Motors, Ltd., of London, and J. S. Castle, his assistant, visited Oshawa, Canada, to confer with the executive of General Motors of Canada, Ltd., upon export problems.

NEW RICKENBACKER MODELS

DETROIT, Sept. 16—A three-passenger coupe-roadster with provision for two additional persons in a rumble seat in the rear deck, has been added to both the six and eight-cylinder Rickenbacker line. The price of the former chassis is $1,695 and of the latter $2,095.

The finish is a two-tone color scheme of dust grey and desert brown, and the upholstery is a velvet velour. The deluxe model on the eight cylinder chassis, which is the same as the standard except for additional equipment is finished with mohair instead of velour for the interior.

Equipment is the same as on other Rickenbacker closed cars and includes the following: "VV" windshield, automatic windshield cleaner, rear view mirror, coincidental lock and stop light.

August Employment Increases Slightly

Bright Outlook for Future, Says U. S. Employment Bulletin

WASHINGTON, Sept. 17—Employment in the automobile industry and allied plants in August showed a small increase, "with a bright outlook for the immediate future," according to the monthly issue of the Industrial Employment Information Bulletin just made public here by the U. S. Employment Service. Increased demands were reported, says the bulletin, for labor in connection with highway construction, with sufficient work already under way to assure steady employment to a great number of men for some time to come.

Detailed Employment Reports

Following are succint employment reports from the principal automotive centers:

Michigan, general: Automobile production has been exceptionally well maintained and promises to continue so.

Detroit Industrial District: At Highland Park a large motor plant is operating 24 hours a day and another large plant is running 16 hours a day.

Muskegon, Mich.: One motor plant is scheduled to increase its working force by 500 men.

New York, general: Automobile plants are keeping large forces steadily employed.

Buffalo Industrial District: Automobile plants, with the exception of one, are operating full time, with full forces.

Troy Industrial District: A slight improvement in operations and employment is noted in the automobile plants at Green Island.

New Jersey, general: A further slight improvement is noted.

Wisconsin, general: Full employment seems to prevail in all of the larger automobile factories.

Figures Announced on Road Building

WASHINGTON, Sept. 16—Twenty-three thousand miles of highways were built to grade or surfaced on State systems in 1924, according to information collected by the Bureau of Public Roads of the United States Department of Agriculture from the various State highway departments. More than 17,000 miles were surfaced.

The surfaced mileage constructed by types was as follows: Sand-clay, 1385; gravel, 7660; waterbound macadam, 467; surface-treated macadam, 1000; bituminous macadam, 997; sheet asphalt, 120; bituminous concrete, 564; cement concrete, 4850, and brick and other block pavements, 164.

The Bureau estimates that at the end of 1923 there were surfaced roads in the State systems totaling 111,400 miles. Adding the mileage surfaced in 1924, after making allowance for the fact that a portion of the new work consisted of the resurfacing of old roads, it is indicated that approximately half of the 251,610 miles embraced in the State systems were surfaced at the beginning of the present year. These figures represent work done under State supervision, including Federal-aid work, but do not include county or local work off the main State systems. Progress in 1925 should be at least as great as in 1924, according to the best information available.

New Design of Motor Car Coaches in Use

SAN FRANCISCO, Sept. 16—Operation of through dining-observation car motor coaches between this city and Los Angeles has just been inaugurated by Pickwick Stages, Inc., according to announcement by this corporation, which adds that these are the first of their kind ever operated. The distance covered is 468 miles and the running time is fourteen hours.

The corporation also announces that it plans to put a number of these coaches in operation between the larger cities of the coast, until, by this time next year, one may travel in them from Vancouver, B. C., to Tia Juana, Mex.

Lincoln Producing New Heavy Chassis

DETROIT, Sept. 16—The Lincoln Motor Co. division of Ford Motor Co. is now producing a chassis fourteen inches longer than standard to meet the existing demand for a high-powered chassis suitable for mounting ambulance, police patrol and funeral coach bodies.

Except for the changes necessary to the frame, propeller shaft and brake rods, the 150 in. chassis is identical with the standard 136 in. model. The price of the new chassis alone is $3,800, while complete with ambulance body it lists at $6,800.

The bodies for the funeral coaches now being built by the coach-makers are in keeping with the high quality of the "standard" bodies, having identical style of design and appearance.

Says Paved Highways Cut Cost of Car Operation

SACRAMENTO, CAL., Sept. 16—Paved highways cut the cost of operation of a motor vehicle approximately three cents per mile, according to W. F. Nixon, secretary of the California State Highway Commission. "The cost of operating a motor vehicle on unpaved roads is about 12½ cents per mile," said Nixon, "as compared to 9¼ cents on paved highways, according to the results of experiments conducted by our engineers."

Firestone Rubber Plans Nearly Ready

At Work on Financing Scheme to Develop Liberian Jungle Land

AKRON, O., Sept. 16—Arrangements for financing the subsidiary company of the Firestone Tire & Rubber Co., which is to develop rubber growing plantations in Liberia, have been nearly completed, it is reported here. Present plans call for the underwriting by a large banking syndicate of approximately $100,000,000 worth of securities, which will form the capitalization of the new corporation.

Edwin Barclay, Secretary of State of Liberia, has approved the leasing, on a long term basis, of 1,000,000 acres of land in the African republic to the Firestone company. He assured H. S. Firestone, president of the company, upon a recent visit to this country, that other government officials are in favor of the proposition. Barclay is now on his way home to submit the lease to his government for final approval.

Mr. Firestone is now in New York with other company officials working on details of financing the project. It is believed the public will be given an opportunity to purchase stock in the new rubber-growing corporation.

The Akron manufacturer, who has long been an advocate of Americans producing their own rubber, has announced that the entire acreage will be placed under cultivation as soon as the land is reclaimed from the jungle. The total cost of developing an acre of such land is estimated by experts at more than $100, in some cases. After being planted, the rubber trees require about five years cultivation before they begin to yield latex, and it is about seven years before a plantation comes into full production.

Peerless Shipments Gain 68 Per Cent

CLEVELAND, Sept. 16—The Peerless Motor Car Co. reports shipments in August that were 68 per cent greater than in the same month a year ago. June sales were 75 per cent greater than in the same month a year ago, while in July, 1925, there was an increase of 50 per cent over July, 1924.

"The indications are that the sales for the remainder of the year will continue to show large increases," says Charles A. Tucker, general sales manager. "Already demand for cars following the latest reductions of prices of the Equipoised eight and the Peerless six have exceeded our most sanguine expectations and necessitate further increases in production schedules."

Stock of this company has risen constantly in price on the exchange here since Edward Ver Linden assumed the presidency.

G. M. August Sales Show Upward Trend

Dealer and Division Figures Show Remarkable Increase Over Last Year

NEW YORK, Sept. 16—The sales of General Motors cars to ultimate consumers in August totaled 76,546 cars and trucks, compared with 54,842 in August, 1924.

Sales of cars and trucks to dealers by the manufacturing divisions of General Motors in August totaled 75,973, compared with 48,614 in August, 1924.

Sales by Months

The following tabulation shows monthly sales of General Motors cars by dealers to ultimate consumers and sales by the manufacturing divisions of General Motors to their dealers:

Dealers Sales to Users

	1925	1924	1923
Jan.	25,593	33,574	31,437
Feb.	39,579	50,007	33,627
March	70,594	57,205	74,632
April	97,242	89,583	105,778
May	87,488	84,715	90,327
June	75,864	65,224	75,423
July	65,850	60,836	62,209
Aug.	*76,546	54,842	56,846

Divisions Sales to Dealers

	1925	1924	1923
Jan.	30,642	61,398	49,162
Feb.	49,146	78,668	55,427
March	75,527	75,484	71,669
April	85,583	58,600	75,822
May	77,223	45,965	75,393
June	71,088	33,984	69,708
July	57,340	40,563	51,634
Aug.	*75,973	48,614	65,999

*These preliminary figures include passenger car and truck sales in the United States, Canada and overseas by the Chevrolet, Oldsmobile, Oakland, Buick and Cadillac manufacturing divisions of General Motors.

REO SALES UNPRECEDENTED

LANSING, MICH., Sept. 14—The recent price reductions announced by the Reo Motor Car Co., have greatly stimulated the sales of both the Reo speed wagon and the various passenger car models, R. C. Rueschaw, general sales manager, said today.

The sale of the speed wagon has gone ahead at an unprecedented rate and is establishing new sales record for this division. Passenger cars also are moving at a fast rate and will claim the attention of the company's sales effort for the next few months.

PEERLESS SALES GROW

CLEVELAND, Sept. 16—"The progress that the Peerless Motor Car Co. has made under the management of Edward Ver Linden, who became president and general manager last year," said Charles A. Tucker, general sales manager, "is indicated by the progressive increase in sales by months. In August, shipments were 68 per cent in excess of August, 1924. This is a repetition of similar records made in the last several months. June sales showed an increase of 75 per cent and July sales were more than double those of a year ago.

"The indications are that the sales for the remainder of the year will continue to show large increase, already demand for cars following the latent reductions of prices of the Equipoised Eight and the Peerless Six having exceeded our most sanguine expectations.

PLAN REORGANIZATION OF SPRINGFIELD BODY

SPRINGFIELD, Sept. 16—The reorganization of the Springfield Body Corp. will be completed within one week and a new concern launched under the name of the New England Body Corp., to make bus bodies on a large scale, it was announced here following a special meeting of the Smith-Springfield Body Corp., the holding concern. Operations will include repair work for buses operated by a number of large concerns, it is said. New capital connected with influential automotive interests is being enlisted and the board of directors will be strengthened, it is stated, by L. L. Homer of New York, who has been active in effecting the reorganization. He said full particulars of the plan would be given out at a later date.

Murray Body Declares Extra Stock Dividend

DETROIT, Sept. 15—Directors of the Murray Body Corp. decided at a meeting held here that, in view of the increase of their business since Jan. 1, and the requirement, therefore, for additional cash, they would conserve cash by omitting the 60-cent dividend usually paid Oct. 1 and, instead, declare an extra stock dividend of 2½ shares per 100 shares, which will be payable Oct. 1, in addition to the regular 1½ shares per 100 shares, payable Oct. 1.

Reports of Merger of Foreign Companies Here

NEW YORK, Sept. 16—The proposed purchase by the General Motors Corp. of the Austin Motor Car Co., Ltd., has been defeated by the opposition of some of the shareholders, according to cabled advices from London that have not been denied here.

Reports of other developments that would result in the entrance of American manufacturers into the European light car field are unabated, however. W. R. Morris, governing director of Morris Motors, Ltd., Cowley, England, has been in Detroit and New York this week, and rumors have linked his concern with several American companies. Morris made about 20,000 cars last year, and 1925 production is said to be at the rate of 45,000 annually.

Cleveland Cuts List and Adds 2 Models

Reductions Range from $50 to $200—New Coupes Now Ready

CLEVELAND, Sept. 17—The Cleveland Automobile Company has just announced the addition of two new models to its 1926 line and has simultaneously cut the prices of the Model 31 Sedan, and the Model 43 sport Touring, Sedan, De Luxe Sedan, and Sport Sedan, the cuts ranging from $50 on the Sport Touring to $200 on the standard sedans of both series.

The new models which have been added to the Cleveland lines are a Coupe on each the "31" and "43" chassis, the model "31" Coupe listing at $975 and the model 43 Coupe listing at $1175. The new coupes are finished in blue with a bead running from the hood to the rear of the car. Wide doors, spacious rear compartments, and genuine leather upholstery feature these new models. Gray corduroy upholstery can be obtained at slightly extra cost. Seats are designed to accommodate three passengers.

New Prices Announced

Following are the Cleveland models which have been affected by the most recent price cut:

Model	New Price	Old Price
Series "31"		
Sedan	$995	$1,195
Series "43"		
Sport touring	1,245	1,295
Standard sedan	1,295	1,495
De Luxe sedan	1,595	1,695
Sport sedan	1,625	1,725

Incorporate New Haven Machine Tool Exhibition

NEW HAVEN, Sept. 12—In order to insure continuity of policy and efforts and better to protect the interests of all concerned the New Haven Machine Tool Exhibition has been incorporated under the laws of the State of Connecticut. The corporation is to have fifteen members, of which nine will be appointed immediately by the chairman of the New Haven Section of the A. S. M. E. from among the members of that section; three will be appointed by the chairman of the New Haven Chamber of Commerce, from among the members of that chamber, and three by the Department of Mechanical Engineering of Yale University, from among the members of that department.

Office Removal Announced

CLEVELAND, Sept. 16—The Cleveland Graphite Bronze Co. announces the removal of its offices and factory from 2906 Chester Ave. to 880 E. 72nd St., in this city.

Standardization of Truck Sizes Studied

Motor Truck Industries, Inc., at Meeting, Limits Them to Four —Addresses Made

BUCHANAN, MICH., Sept. 16—Nearly 100 truck and parts plant executives attended the meeting of Motor Truck Industries, Inc., here today. Fourteen truck manufacturers by resolution adopted the report of the ratings committee on the limitation of sizes to be built, as a basis for the different group committees to work on. The sizes are limited to four, namely: fast freight class, 1-ton and 1½-2 tons; heavy duty class, 2½-3 tons and 4-5 tons.

The meeting was the largest and most enthusiastic held so far, and various committees are going ahead with plans for the next meeting, to be held in Washington on two days of the week of Nov. 8, at the invitation of the Department of Commerce.

Dawes and Campbell Speak

William R. Dawes, vice-president of the Central Trust Co. of Illinois, addressed the meeting on the subject of greater protection for loans. He commended the standardization work proposed and voiced the opinion that it would help both manufacturers and dealers, because it would result in better inventories and better credit. "The worst problem the banker has to contend with," said Mr. Dawes, "is to know what to do with the assets of defunct truck manufacturers. Bankers know how difficult it is to dispose of truck parts, for which only junk prices can be obtained." He added that he believed there was an era of prosperity ahead, extending over the next four or five years, that there would be no money stringency and no inflation. In conclusion he said that the manufacturer must plug leaks by more attention to minor business details, and that fair dealing, maintenance of the quality of the product, the acceptance of reasonable returns, and careful scrutinizing of credits would determine the results to be attained by the real business man. Touching on European conditions, he stated that American business men must accept the leadership there, if entire recovery is to be made.

H. Colin Campbell discussed highway improvement as affecting standardization of automotive products. He compared the standardization program with the problems met with in the cement industry, and said that the Portland cement business was now down to one standard. He called attention to the fact that 30 per cent of the cement now produced in this country goes into highways and said the use of motor vehicles had forced the building of better roads. He foresaw the construction of 6,000,000 trucks during the next five years because of these improved road conditions, and added that lighter trucks, twice the mileage, smaller automobiles and the great increase of closed car sales were direct results of improved roads. In conclusion, he commented on ill-advised taxes and the misuse of gasoline tax funds.

Directors and members were entertained by officers of the Clarke Equipment Co. at their plant. It was announced that twenty-five new members had been admitted.

Expect to Enlarge Distributing Force

LANSING, MICH., Sept. 16—Sales of Duplex trucks in the last three months have increased 300 per cent over the corresponding period for last year, according to A. J. Shaw, sales manager of the Duplex Truck Co.

"The fact that there are already thousands of Duplex trucks giving satisfactory service in all parts of the country, and in many foreign countries as well," states Mr. Shaw, "convinces us that there is a market for Duplexes in practically every line of transportation, and plans are now under way for materially enlarging our distributing organization."

Ford Offers Government Small Dirigible Plans

WASHINGTON, Sept. 17—Construction of an all-metal "flivver" dirigible, invented by engineers of the Ford Motor Co., is being seriously considered by the Navy Department, Secretary Wilbur declared here this week.

A group of Detroit experts, including William B. Mayo, chief engineer for Ford, have laid before the Bureau of Aeronautics complete details, illustrated by a model, of such an airship which, they assert, will answer all the purposes of the Shenandoah, but will be smaller, safer and less expensive. Mayo and his associates offered to turn over all of their data—the results of four years' experiments—so that the Navy can build the dirigible at its Philadelphia aircraft factory.

The Ford dirigible would cost approximately $300,000, as compared with $2,000,000 for the Shenandoah. It would have the general shape of an egg, 150 ft. long and 50 ft. at its greatest width. The motors would propel it at a cruising speed of sixty miles an hour, and its cruising range would be 2000 miles.

Crude Rubber Consumption

WASHINGTON, Sept. 17—Domestic consumption of crude rubber in the first seven months of this year totaled 233,875 long tons, according to statistics made public this week by the Department of Commerce, based on reports from 457 American factories using that commodity. The department announces that the factories from which reports were not received are few, and that it is understood that their use of crude rubber had not been large.

Business in Brief

Written exclusively for AUTOMOTIVE INDUSTRIES *by the Guaranty Trust Co., second largest bank in America.*

NEW YORK, Sept. 18—Further definite gains were noted in industrial and trade activity after last week's holiday, despite the continuance of extreme heat and drought in certain agricultural districts. Stock market quotations were generally firm while commodity prices moved irregularly, with a slight downward tendency.

The official crop report based on conditions Sept. 1 estimated the total yield of corn at 2,885,000,000 bu., as compared with last month's forecast of 2,950,000,000 bu. A substantial gain was recorded in the prospective yield of spring wheat, the estimated total of 284,000,000 bu. comparing with the earlier forecast of 263,000,000 bu. The cotton crop report placed the probable harvest at 13,740,000 bales, or 250,000 bales below the estimate a fortnight earlier. Cotton ginned prior to Sept. 1 amounted to 1,892,549 bales, as against 947,494 bales in the corresponding period last year.

Car loadings reached the highest total on record in the week ended Aug. 29, numbering 1,124,436 and comparing with 1,080,107 in the preceding week and 1,020,809 in the corresponding period last year. The previous record was reached in the week ended Oct. 24, 1924, when 1,112,345 cars were loaded.

Consumption of lint cotton last month was 448,665 bales, as compared with 482,898 bales in July and 357,380 in August last year.

Building contracts awarded in thirty-six states last month, as reported by the F. W. Dodge Corporation, exceeded all previous records. The total value was $589,690,200, which compares with the previous record of $546,970,700 in April, and brings the value of contracts for the first eight months of the year to $3,778,792,000, or 25 per cent more than last year's corresponding total.

Fisher's index of wholesale commodity prices stood at 158.1 last week, as against 158.4 in the preceding week and 160.6 four weeks earlier.

Earning assets of the Federal Reserve banks increased $64,200,000 during the week ended Sept. 9, with $62,300,000 of the gain in discounts alone. Note circulation rose $42,400,000 and total deposits $8,800,000, while total reserve decreased $17,000,000. The reserve ratio declined from 74.8 to 73.4 per cent.

Loans of reporting member banks increased $100,000,000 during the week ended Sept. 2, while investments declined $28,000,000 and borrowings from Federal Reserve banks increased $3,000,000. Net demand deposits rose $93,000,000.

Automotive Demands for Steel Continue

Tractor Plant Inquiry Shows Increase—Sellers Content with Prices

NEW YORK, Sept. 17—So far as automotive demand is concerned, the steel industry continues to enjoy a very gratifying volume for immediate shipment. What tapering-off there may be planned in the operating schedules of automotive plants later in the fall is, so far, not reflected in any curtailment of the number of orders placed for steel. Individual commitments continue very light, but, numerically, orders are impressively large. What slight decline is noted in the purchases of a few passenger motor car manufacturers is more than made up for by increased inquiry from tractor plants.

Cold-rolled strip steel is among the best sellers, and mills specializing in hot-rolled flats (the semi-finished material of the cold-rolling mills) are operating at a high rate.

Price Uncertainty Continues

Demand for full-finished automobile sheets is fair. Non-integrated sheet plants appear to be able to cover their sheet bar requirements at $33.50, Youngstown, although some of the larger Monongahela Valley producers continue to hold out for $35. It is doubtful whether or not they are getting much business at this price level, and they may be said to be virtually out of the market pending further readjustment thereof. Cold-finished steel bars move freely to automotive consumers, but in small tonnages at a time. The market for bolts and nuts presents a firm appearance, and some tentative inquiries for fourth-quarter shipments are being received by producers. On the whole, sellers appear to be fairly well content with the stationary behavior of prices, and automotive consumers seem little inclined to bring any pressure to bear on the market. While the latter would resist attempts to lift prices, they consider the facility with which they can cover their hand-to-mouth needs of greater value at this juncture than any saving they might be able to effect through anticipating their requirements and engendering more keen competition among producers, which tonnage business would be certain to bring out. If there is any disturbing factor in the situation from the producers' point of view, it is that all efforts to build up a backlog of orders, sufficient to frame operating schedules for a month in advance, have so far proved futile.

European Pig Iron Competition

Pig Iron.—It appears to be extremely difficult to bring prices in other consuming markets to the parity of Chicago and Pittsburgh where a 50c. per ton advance has become, at least nominally, effective. Competition of imported pig iron is still a factor to be reckoned with, shipments from Germany to New England points recently showing plainly that potentially every European iron-producing country is a competitor of the American blast furnace when price is even moderately an inducement.

Aluminum.—The 20 cent-bid, at which the sole American producer of virgin aluminum is reported to have obtained the aluminum alloy scrap contents of the ill-fated dirigible "Shenandoah," is somewhat higher than the general market for kindred secondary metal, this bid having apparently been prompted by a desire to take this metal off the market. Arrivals of imported ingots continue unaltered in extent. Prices are unchanged.

Copper.—Attempts to lift the price of copper to the 15-cent level continue. Automotive demand for copper and brass products is normal.

Tin.—See-saw conditions again make the outlook uncertain.

Lead.—While somewhat more steady, the lead market is still in light supply, with prices abnormally high.

Chevrolet Tells of Schedule Revision

NEW YORK, Sept. 16—Sustained demand and a growing list of unfilled orders has caused the Chevrolet Motor Co. to increase heavily its production schedule during September.

The schedule revision involves an increase of more than 16 per cent over the production program originally planned for September, and calls for 53,165 motor cars and trucks, a Chevrolet record for that month, and only 3078 less than the highest production month in the history of the company.

Both day and night shifts have been augmented to maintain the new schedule. The company shipped 4284 cars to dealers on Aug. 31, establishing a new record 600 higher than the largest previous shipment for one day.

The company which recently made its two-millionth car, attained in August a greater production thus far for 1925 than the entire production of 1924.

SEAMAN BODY INCREASES FORCE

MILWAUKEE, Sept. 16—More than 500 men are to be added to the working force of the Seaman Body Co., makers of Nash and Ajax bodies, on completion of its new plant here. The plant will be finished within a short time. More than 4000 men are now employed at the plant, and it is probable that the force will be increased to 5000 if demand for bodies continues at the present rate.

The plant is turning out 450 bodies daily and this number will be increased to 600 through addition of new facilities. Sufficient business is in sight to assure high-speed operations for the remainder of the year.

FINANCIAL NOTES

Durant Motors of Canada, Ltd.—Excerpts from the balance sheet of this company as of July 31, 1925, together with comparative figures for Dec. 31, 1924, are as follows:

	July 31, '25	Dec. 31, '24
Land, buildings, etc. (less depreciation)	$1,508,935	$1,544,413
Cash	375,250	303,277
Notes and accts. receiv.	498,163	82,147
Inventory	1,135,241	1,215,330
*Cap. stock	3,000,000	3,000,000
Accts. pay.	48,833	205,283
P. & L. surp.	306,799	d60,049

*Includes stock subscribed for, but unissued. d Deficit.

The Omnibus Corp.—The subsidiaries of this company report gross income for the first seven months of 1925 as follows:

	1925	1924
Chicago Motor Coach Co.	$3,446,000	$2,730,000
Fifth Ave. Coach Co. of N. Y.	4,149,000	3,500,000

In the first week of September, 1925, the Chicago company's gross income increased $44,000, and the New York company, $30,000, over 1924.

A. O. Smith Corp.—A 25-cent dividend on common stock has been declared by this corporation, in addition to the regular 25-cent quarterly dividend. The regular dividend rate has not been advanced but a big increase in the volume of business warranted the payment of an extra dividend, company officials said.

Dodge Brothers, Inc.—First $5,000,000 of six per cent convertible debenture bonds have been surrendered for conversion into Class A common at $30 per share. These bonds were sold to the amount of $75,000,000 and the next $5,000,000 block presented may be converted into Class A common at $35 per share.

J. G. Brill Co.—The Committee on Listing and Securities of the New York Curb Exchange has admitted to listing 50,000 authorized shares J. G. Brill Co. 7 per cent cumulative preferred stock, par value $100, and 48,102 authorized shares common stock, par value $100.

Commercial Credit Co.—This company has applied to the Governing Committee of the New York Stock Exchange to list $4,000,000 preferred stock ($25 par value); $4,000,000 Class "B" preferred stock ($25 par value), and 480,000 shares of no par common stock.

New York Transportation Co.—Directors of this company (controlling the stock of the Fifth Avenue Coach Co.) have declared the regular quarterly dividend of 50 cents a share, payable October 15 to stockholders of record as of October 1, 1925.

Auburn Automobile Co.—The Committee on Listing and Securities of the New York Curb Exchange has admitted to listing Auburn Automobile Co. 60,000 authorized shares common capital stock, par value $25.

Goodyear Tire & Rubber Co. of Canada, Ltd. This company has declared its regular quarterly dividend of 1¾ per cent on the preferred, payable Oct. 1 to holders of record of Sept. 19.

Men of the Industry and What They Are Doing

Anderson Advertising Manager

The Standard Motor Truck Company of Detroit announces the appointment of R. E. Anderson as advertising manager. Mr. Anderson has a wide experience in publicity and advertising work, being chiefly familiar with promotional work as it applies to the motor truck industry.

Mr. Anderson will direct the advertising of the Fisher Fast Freight which was recently introduced by the Standard Motor Truck Company. This truck is named for Albert Fisher, founder of the Fisher Body Corporation and the Standard Motor Truck Company. Mr. Fisher created this truck to meet the demand for a vehicle that will carry 1½ ton loads at a higher rate of speed. It is equipped with a 50-hp. motor capable of developing 40 miles per hour.

Prentiss Made Manager

D. S. Eddins, General Sales Manager of Olds Motor Works, announces the appointment of Don Prentiss as Manager of the Sales Promotion division of the Olds Motor Works. Mr. Prentiss has had years of experience in merchandising automobiles. He has been in business for himself and has spent several years actively engaged in working with a dealer organization and in building up an efficient retail selling organization. As head of the sales promotion department he will work very closely with Oldsmobile dealers throughout the country.

Hoffman Speaks in Charlotte

The automobile as a means of National defense against Bolshevism was commended by Paul G. Hoffman, vice-president of the Studebaker Corporation of America, addressing a conference of eighty-five Studebaker dealers from North Carolina, South Carolina and Southern Virginia in Charlotte, N. C., recently.

Van Fleet to Peerless

F. A. Van Fleet, for the last ten years managing editor of the State *Journal*, Lansing, Mich., has been appointed advertising manager for the Peerless Motor Car Co. For a number of years he was engaged in editorial work in Detroit, specializing on the automobile industry. He was at one time secretary to the Mayor of Detroit.

Freitag to Kissel Motors

Reuben C. Freitag, formerly with the Everwear Hosiery Co. of Milwaukee, Wis., has been named general advertising and publicity manager for the Kissel Motor Car Co. of Hartford, Wis. He succeeds Elliot B. Field who resigned some months ago.

R. C. Rueschaw

General Sales Manager of the Reo Motor Car Co., Who Has Returned to His Desk After an Absence Due to Illness

CINCINNATI COMPANY ELECTS NEW OFFICERS

CINCINNATI, Sept. 16—At a reorganization meeting of the board of directors of The Cincinnati Electrical Tool Co., the following officers were elected: Joseph Wolf, president and treasurer; R. K. LeBlond, vice-president; Edward G. Schultz, secretary.

The company is planning shortly to move into larger quarters and expand their business in a general way, according to a statement by President Wolf.

McCormick to Milwaukee

Malcomb McCormick, formerly sales manager of the McCord Radiator & Mfg. Co., Detroit, has joined Milwaukee Products, Inc., Milwaukee, Wis., manufacturer of Milwaukee timers, as director of sales and advertising, succeeding W. P. Ferris, who has resumed active management of the Pressed Metal Mfg. Co., Waukesha, Wis.

Reeves to Speak

Alfred Reeves, general manager of the National Automobile Chamber of Commerce, will talk on "The Outlook for Trade Associations" at the National Babson's Conference, Wellesley Hills, Mass., Sept. 26.

Kerby Promoted

R. D. Kerby, who was recently appointed sales manager of Durant Motors of Canada, Ltd., has been advanced to the position of assistant general manager, in charge of operations.

Sergarde and O'Brien to Reo

R. C. Rueschaw, general sales manager of the Reo Motor Car Co. has announced that Thomas T. O'Brien, formerly assistant sales manager of the Olds Motor Works has joined the sales organization of the Reo Motor Co. and will specialize in the sales of buses and taxicabs.

Fabio Sergarde, who for a number of years was chief engineer of the Olds Motor Works, has joined the engineering force of the Reo Motor Car Co., according to an announcement recently made by H. T. Thomas, vice-president and chief engineer of the Reo company.

Campbell Makes Address

The summer convention of the North Carolina Automotive Trade Association was addressed by Colin Campbell of New York, vice-president of Durant Motors, Inc. Mr. Campbell's address was delivered at a banquet attended by approximately 200 automobile distributors, dealers, salesmen and shop foremen.

Zimmer Gets Promotion

L. M. Zimmer has been appointed general sales manager of the Linde Air Products Co., and of the welding gas division of the Prest-O-Lite Co., Inc., manufacturer of dissolved acetylene, succeeding L. M. Moyer, resigned. Mr. Zimmer joined the Linde concern nine years ago as junior salesman. Most of the time he has represented the company in the Middle West, coming to New York in 1924 to act as assistant general sales manager.

Kruse Leaves Trade

H. M. Kruse has resigned as General Sales Manager for the Clifton Manufacturing Co. of Waco, Tex., manufacturers of automobile fabric items, and is leaving the automotive field to join the floor covering department of the Paraffine Co. of San Francisco.

North with Aladdin Service

Bert North, who has been connected with the automobile industry since 1901 as an advertising and publicity man, has joined the staff of the Aladdin Art and Advertising Service, with offices at 849 Broad Street, Newark, N. J.

Cagwin Named Representative

C. E. Thompson, president of the Steel Products Co., Cleveland, announces the appointment of T. P. Cagwin as his personal representative for the Steel Products Co. and Thompson Products, Inc., both manufacturers of automobile engine valves and chassis parts. Mr. Cagwin was formerly an official of the Gibraltar Savings Co., Cleveland.

Willys-Overland Enlarging Plant

TOLEDO, Sept. 16—Preparing for a big increase in production next spring, the Willys-Overland Co. here is now going forward with its improvement plan, which includes the building of a new forge shop, new heat treating plant and warehouse, a program involving between $2,000,000 and $3,000,000. The forge shop will be 750 by 75 ft.. The heat treating plant will be 570 by 75 ft. The power plant will be completely remodeled, with new 500-hp. boiler capacity and most modern stoker equipment.

Plans for the structures are being prepared by the engineering department of the company and will be in the hands of contractors in a few days. Necessary pilings for some of the building footings are being put in by the plant construction department. There are nearly 12,000 men at work in the plant, and additions are expected to be made to keep production at a high level during the rest of the month. A solid train of 85 cars carrying 350 motor cars was dispatched from the plant here a few days ago for Memphis to the Burt Overland Co., breaking another transportation record. W. T. Burt, head of the distributing firm, says he expects big business on the standard sedan at the new price.

CUNNINGHAM PRICE ADVANCE ANNOUNCED

ROCHESTER, Sept. 16—James Cunningham, Son & Co. has announced price increases of $350 on the open models and $400 on closed models. This is the second price increase made by Cunningham inside of two months, prices now being from $700 to $850 higher than they were in July. Following are latest prices and those in effect previously:

Model	New Price	Old Price
Touring	$7,000	$6,650
Sport touring	6,500	6,150
Coupe	8,000	7,600
Limousine	8,500	8,100

CHRYSLER EXPANSION PLANS

DETROIT, Sept. 16—Purchase of the local plant of the American Motor Body Corp. by the Chrysler Corporation is the first step in an expansion program now contemplated by the Chrysler Co., it became known here today.

Present plans call for the upper three floors being used for body production, and the lower two for machine shop work.

Automotive Taxes Show a Decrease

WASHINGTON, Sept. 17—The automotive industry contributed $124,686,745.30 to the Internal Revenue Bureau for the fiscal year ended June 30, 1925, according to a preliminary statement of the Treasury Department, just made public. This is considerably less than the $158,014,709.40 which the industry paid during the fiscal year ending June 30, 1924.

The decrease is normal, as total collections from all sources of revenue for the fiscal year 1925 were $2,584,140,268.24, or $212,038,988.82 less than the receipts for the fiscal year ended June 30, 1924.

Receipts from automobile trucks and automobile wagons for the fiscal year ended June 30, 1925, were $7,807,811.16, or $3,702,751.89 less than in 1924. Receipts from "other automobiles and motor cycles" were $94,141,539.29, or $18,728,987.27 less than in 1924, and receipts from tires, parts or accessories were $22,737,384.85, or $10,896,224.93 less.

MOON MOTOR SALES

ST. LOUIS, Sept. 16—Moon Motor Car Co. announces that August sales were 25 per cent ahead of July, and that 48 per cent of cars sold in August were Dianas.

Developments of the Week in Leading Motor Stocks

NEW YORK, Sept. 17—The credit situation is confused this week by the Treasury operation, which included income tax payments, the payment and refunding operations of the Government and the issuance of new short term securities. This has left no clear-cut indication of any substantial change, and probably it will be a fortnight before the exact situation can be determined. Stocks have been strong during the period under review, with many issues establishing new high records, and with every indication of a large public participation. Transactions of more than two million shares were recorded on one day, a degree of activity not seen since last May. The automotive stocks have been the leaders, not only in volume but in strength.

There has been little of fact upon which to hang the patent manipulative activities of recent sessions. It is true that the motor industry is making history this year in that production and sales, which now are corelated by all manufacturers, are holding at levels never before attained at this season of the year. Certainly the market gives no indication of the dire prophecies so freely made a few months ago, when, according to Wall Street report, there were to be only four motor manufacturing groups left.

This subject of consolidation and elimination is close to the speculative heart. It is recognized as a fundamental economic force in the industry. But necessitous consolidations are one thing and those of strong companies, financially sound and well established in their field, are quite another. Wall Street now is viewing the possibilities of mergers from the optimistic angle of the latter view rather than from the pessimistic angle of the former.

Studebaker, after trying the patience of its friends for many months, became one of the active leaders of the motor group during the week and sold at the highest price ever recorded for the present stock. The advance was accompanied by reports that the dividend would be increased, either through the declaration of an extra payment of $1 per share or by the establishment of a higher annual rate. Pierce Arrow is under the market control of a powerful speculative group, which advances the price without rumor, by the brute force of buying. Hupp had its day in the sun, with a special appeal to those who favor low-priced issues. Here there were reports of large earnings and a possible consolidation with an unnamed company. Chandler, in which a large short interest long has slumbered, awakened, to the discomfiture of the shorts, who in their attempts to extricate themselves from their unpleasant position, bid the price up nine points.

In the truck group the violent fluctuations of Mack Trucks were meaningless save as they represented the desire of professional traders to obtain a nimble profit. An interesting incident was the advance in American Car & Foundry upon the report that it is to enter the truck field. White Motors was reactionary following its recent excited advance to 104, the decline representing the desire of speculators to turn paper profits into cash.

There are indications of renewed activity and interest in the rubber and tire stocks. Following a ten-point reaction which came concurrently with a decline in the price of crude rubber, United States Rubber met substantial support. The company reports a large demand for mechanical goods for which the season is approaching. The other tire stocks fluctuated generally in sympathy with this leader of the group.

A sharp advance, temporary in character, in the sugar stocks and continued strength in the copper stocks featured the market for the raw materials issues. In the case of the former, surplus stocks of sugar are being reduced, and the technical position of these stocks has been strengthened by their considerable decline in price. In the case of the copper companies, the reduction in the supplies of refined metal on hand to a bare two weeks' supply, as reported by the American Bureau of Metal Statistics, serves further to emphasize the strong statistical position.—H. H. S.

Panhard Levassor Hangs Up Records

Speed of 115.36 Miles an Hour Made at Montlhéry—Other Records

PARIS, FRANCE, Sept. 1—A distance of 115.36 miles, covered in an hour by Ortmans, driving a four-cylinder Panhard Levassor car on Montlhéry track, near Paris, recently, is claimed as a world's record and will be put up as such to the International Association of Recognized Automobile Clubs. The previous record for this distance was 109.02 miles an hour, established by J. Parry Thomas on a straight-eight Leyland Special.

In addition to the hour record, the Panhard Levassor captured four other world's records: 50 kilometers in 16 min. 19 77/100 sec. (old record 16 min. 22 67/100 sec.); 50 miles in 26 min. 4 13/100 sec. (old record 26 min. 10 69/100 sec.); 100 kilometers in 32 min. 19 89/100 sec. (old record 32 min. 30 66/100 sec.); 100 miles in 51 min. 59 29/100 sec. (old record 55 min. 11 26/100 sec.).

The car had a Panhard Levassor Knight type sleeve valve engine with four cylinders of 4 by 5.5 in. bore and stroke. This engine has steel sleeves, with the inner surface of the outer sleeve white metalled, and was capable of turning up to 5000 r.p.m. Michelin clincher bead low pressure tires of 165 mm. (6½ in.) section were used, the tires being held on the rim by the Michelin continuous safety lug, which is a duralumin band with tough rubber links, bedding down on to the inside of the tire bead by means of six screws going through the rim of the tire. This is the first occasion of the use of a tire of this size for high speed work. Several previous Panhard Levassor attempts to get the hour record have failed owing to tires.

Prominent French Manufacturer Sails

PARIS, FRANCE, Sept. 12—Among the passengers aboard the "Paris" sailing from France Sept. 16 will be E. C. Mathis, automobile manufacturer of Strasburg. Mr. Mathis will make his headquarters at the Plaza Hotel, New York, and will spend at least a month in the United States visiting automobile factories and inquiring into labor-saving devices and modern American manufacturing methods and machinery.

With his works under German domination in 1914, Mr. Mathis was obliged to spend the whole of the war in Alsace, and the Armistice found him with a factory stripped to the bare walls. In 1919 plans were laid for the construction of a new factory, which is now completed. It has an area of 1,200,000 sq. ft., of which 1,184,000 ft. are covered and stands third in importance of output in France. In addition to the main factory in Strasburg, on French territory, Mathis has an assembly plant nearby on the east bank of the Rhine, thus enabling him to compete advantageously in the German market.

NOTES ON AVIATION ACHIEVEMENTS ABROAD

NEW YORK, Sept. 16—Some interesting notes on aviation from abroad recently received include word of a new speed record over 1000 kms. (621.5 miles), established by the French racing pilot, Lasne, flying a Nieuport-Delage, with a 450-hp. Hispano-Suiza. He covered 10 laps of the Villesauvage-La Marmogne 100 km. course in 4 hours 31 minutes 38.8 seconds, averaging 155 miles per hour. The previous record over this distance was 137.83 m.p.h., held by the Frenchman, Doret.

Russians are participating in the glider meet at Rhoen in Germany this year, the first time that they have actively entered contests outside of Russia.

Fifty million dollars of reparations bonds have been delivered to England by the German debt commission, the bonds being shipped to England by aeroplane, one of the new Junker G-24 planes being used. It is significant that aeroplane travel abroad is considered so safe as to permit the adoption of this method of transportation for so valuable a cargo.

Automobiles Lead In Canada's Exports

TORONTO, Sept. 16—Automobiles stand highest in the list of manufactured articles among Canada exports, Thomas A. Russell, president of the Automotive Industries of Canada, said in his address at the directors' luncheon at the Canadian National Exhibition automotive industries day held last week. In the twenty-one years of the industry in Canada, and chiefly in the last ten years, production of motor cars in Canada has reached $80,000,000, Mr. Russell said. Motor cars are seventh in the value of products of all classes in Canada, but in Canadian exports are only exceeded by grain, pulp, and paper products and wood and wood products. Mr. Russell stated that Canada has a favorable balance of trade of $130,000,000, in the matter of interchange of motor traffic with the United States. Other prominent speakers included Sir William Letz, president of the Society of Motor Manufacturers and Traders of Great Britain and C. F. Kettering, president of the Society of Automotive Engineers of the United States.

Racer Embodies New Construction Ideas

Chenard-Walcker, Which Won Boulogne Road Race, Has Novel Features

PARIS, FRANCE, Sept. 1 (*by mail*)—The Chenard-Walcker car of 67 cu. in. piston displacement, with which A. Lagache recently won the Georges Boillot handicap road race at Boulogne, embodied many distinctive features. The four-cylinder engine had two big diameter vertical intake valves and one very small exhaust valve in the head, with operation by pushrods and overhead rockers, and at the base of the cylinder there was an auxiliary rotary exhaust valve. As the greater portion of the exhaust gases were discharged at the bottom of the stroke, the exhaust in the head did not need to be large, thus leaving space for two big inlets. Another advantage of this design, for which Engineer Touté was responsible, was that, with the additional exhaust port, spark plugs did not overheat or give trouble. Although there were three valves in the head, room was found for the spark plug also in the cylinder head, the plug as well as the valve operating gear being under an oil tight aluminum cover.

The chassis and the body formed one construction, the width of the body being equal to the full length of the car, thus enabling the front wheels to be encased without interfering with steering. A narrower track was used at the rear, and the driving wheels were entirely hidden. Duralumin was used throughout for the body panelling. This type of body was accepted by the jury as being in accordance with touring practice, although being a distinct departure.

On the varied Boulogne roads the small Chenard-Walckers showed themselves equal in speed to cars of twice their piston displacement and, under the handicap, the larger cars had no chance of catching them. Three cars started, but two were forced out with defects not associated with the engine.

British Car Builders to Have Canadian Plants

TORONTO, Sept. 16—Next year four leading English motor car manufacturers will establish Canadian plants, according to an interview given, by Col. A. Hacking, D.S.O., M.C., manager of the British Society of Motor Manufacturers and Traders. The firms mentioned are Morris, Austin, Humber and Standard.

MOTO-METERS IN AUSTRALIA

NEW YORK, Sept. 16—The Moto-Meter Co., Inc., of Long Island City, has granted a license to Nolan-Smith, Ltd., of Australia, to manufacture Moto-Meters in Australia.

Coming Events

SHOWS

Sept. 14-19 — Cleveland, Public Auditorium, Annual Convention and Exposition, American Society for Steel Treating, W. H. Eisenman, secretary.

Sept. 21-26—London, England, Annual Cycle and Motorcycle Show under auspices of the British Cycle and Motorcycle Manufacturers and Traders Union, Ltd.

Sept. 28-Oct. 3—Chicago, Fourteenth annual Safety Congress and Exhibit, Rainbow Room, Hotel Winton, under direction of National Safety Council, A. M. Smith, business manager.

Oct. 5-9—Atlantic City, Young's Million Dollar Pier, Manufacturers' Exhibition in connection with American Electric Railway Association Convention.

Oct. 8-17—London, Olympia passenger car show.

Oct. 18-31 — Salonica, Greece, First International Sample Fair.

Oct. 29-Nov. 7—London, annual truck show.

Nov. 26 - Dec. 6 — Berlin, Germany, Annual Automobile Show in the Kaiserdamm.

CONVENTIONS

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Oct. 5-9—Atlantic City, Young's Million Dollar Pier, American Electric Railway Association.

Oct. 7-10—Montreal, Motor and Accessory Manufacturers Association Convention.

Oct. 21-23—Boston, Fall Meeting, American Welding Society.

RACES

Sept. 19—Syracuse, N. Y.
Sept. 30—Fresno, Cal.
Oct. 10—Baltimore-Washington Speedway, Laurel, Md.
Oct. 11—Charlotte, N. C.
Oct. 12—Salem, N. H.
Nov. 26—Los Angeles.

S.A.E. MEETINGS

National

Nov. 12-13—Philadelphia, Automotive Transportation meeting.
Nov. — Service Engineering meeting.

A. O. Smith Reports Business Booming

MILWAUKEE, Sept. 16—The A. O. Smith Corp. which manufactures frames for Chevrolet, Buick, Oakland, Oldsmobile, G.M.C. Truck, Oakland, Hupmobile, Nash, Reo, Chrysler, and other cars, is producing between 5000 and 6000 frames daily. During June, July and August, business was 90 per cent ahead of the same months in 1924. The production schedule for the remainder of the year calls for continued production of between 5000 and 6000 frames daily. This rate of production is close to the point reached during the boom years.

"Automobile manufacturers are working along conservatively," said John Kelly, sales manager for the company. "They are gaging their production schedules by the volume of retail sales. Dealers no longer load up with a big stock of cars. The financing involved is too much of a load for the average dealer. This has forced the manufacturer to keep his output in step with demand and there is little danger of a flood of surplus cars.

"Every barometer seems to point toward a good trade in this part of the country in 1926. General business is improving right along. There is a promise of bountiful crops which will be marketed for good prices. If general business and agriculture prosper, the automobile will prosper too.

TEXAS MOTOR REGISTRATION

AUSTIN, TEX., Sept. 16—Motor vehicle registration in the State Highway Department continues to increase at a rate which shows that automobile and motor truck trade in Texas is in a most flourishing condition, notwithstanding the drouth that has caused a crop failure in a big scope of the central and southern parts of the State. In the period from Jan. 1 to Sept. 15, a total of 818,787 motor vehicles were registered. This was about 19,000 more than for the whole of last year. It is expected that the total registrations for 1925 will reach 1,000,000 motor vehicles as there is usually a heavy buying of automobiles and motor trucks in October, November and December. The number of automobiles registered up to Sept. 15 was 549,400; motor buses, 3056; tractors, 238; motorcycles, 2480; commercial vehicles, 78,254; transfers, 183,-359. There has been a large increase in the number of motor buses in the last few months.

NEED OF RENEWING TRADE MARKS SEEN

NEW YORK, Sept. 16—The need for warning automobile companies to attend promptly to the renewal of expiring trade marks is seen by several men of the industry here who have had occasion to look into the situation.

Many trade marks are expiring this year, as the present Federal Act under which they were issued for twenty-year terms was passed Feb. 20, 1905, and made effective April 1, 1905. Applications for a renewal should be made six months prior to the date of expiration or the registration automatically lapses.

In some instances, it is reported, company executives have overlooked the necessity for applying for renewals.

Air Race to Celebrate Round-the-World Flight

LOS ANGELES, Sept. 16—A 100-mile air race, sponsored by the Southern California Chapter of the National Aeronautical Association, will be held in Southern California, Sept. 27, commemorating the first anniversary of the round-the-world flight end at Clover Field. Present indications point to an entry of at least fifty planes, with the Army, Navy and commercial aviation folk of California and other sections competing for the trophy that will go to the winner of similar events to be staged by the newly formed chapter of the N. A. A. each year on the anniversary of the world flight finish.

Names Detroit S. A. E. Committee Chairmen

DETROIT, Sept. 16—W. R. Strickland, chairman of the Detroit section of the Society of Automotive Engineers, has just announced the appointment of the several committee chairmen who will be in charge of the section's activities during the coming winter season.

L. Clayton Hill, who was until last spring assistant general manager of the National S. A. E. body, will head the meetings' committee. Mr. Hill's experience as organizer of the S. A. E.'s National meetings for the last five years qualifies him for this important position. A large committee is being organized to assist him and this will include many of Detroit's leading engineers, production experts and body designers.

Phil Overman has been appointed chairman of the entertainment committee. Membership extension will be directed by D. E. Anderson. The reception committee is being organized under the chairmanship of H. L. Brooke.

Officers of the Detroit Section for the coming year include, besides Mr. Strickland, L. M. Woolson, vice-chairman; R. M. Anderson, secretary; E. V. Rippingille, treasurer.

A. A. A. Declares War on Acts of Roadside Courts

WASHINGTON, D. C., Sept. 17.—As the result of a survey of the operation of roadside courts and speed traps in the United States, the American Automobile Association has declared war against the system.

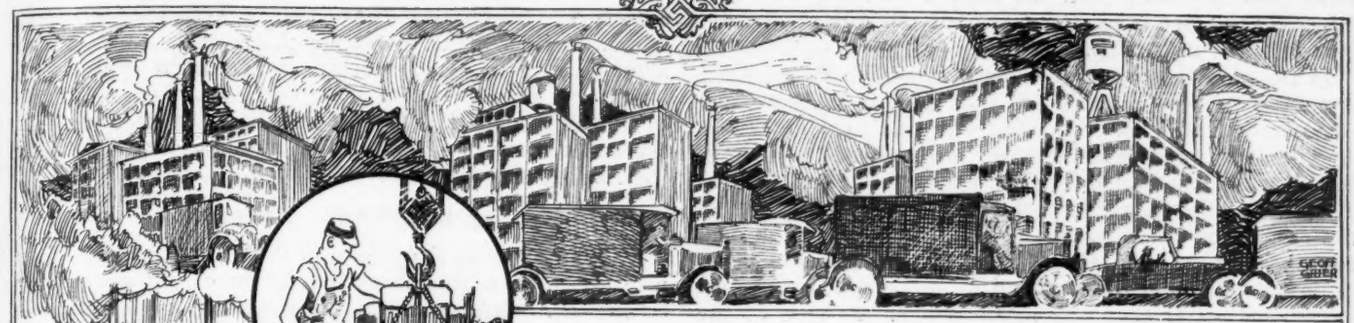
Investigation has proven, according to Association officials, that fully 90 per cent of the roadside courts and the speed traps now active are operated for revenue only and not for the enforcement of motor vehicle regulations.

President Henry called attention to a law passed by the State of California declaring speed trap evidence incompetent to secure conviction. He said: "This is a very proper and progressive piece of legislation and if other States adopted it, the problem would be largely solved."

Production and Factory Equipment Issue

AUTOMOTIVE INDUSTRIES

VOLUME 53 — *New York, Thursday, September 24, 1925* — NUMBER 13



1925 Profits Best Indication of Production Progress

High Earning Power in Face of Declining Prices Due to Better Manufacturing Methods

By W. L. Carver

THE story of development in production methods for 1925 is crystallized in the current profit and loss statements of automotive manufacturers.

When considered by themselves, these statements present the apparently ambiguous combination of increased profits in the face of declining prices, improved quality and a rate of production which is not out of line with the figures for the two previous years.

General prosperity, better handling of the used car situation, a very excellent export market and more adequate merchandise planning all are sidelights on this situation, but the foundation is manufacturing methods which are compatible with a highly competitive industry.

In this issue *Automotive Industries* discusses developments in many of the manufacturing channels taken by the industry as a whole, but the salient features of any or all of these topics could be collected from the plant of any one of the dozen leaders in the industry. In spite of the momentary slumps of recent years, the long swing curve has been profitable and most of these plants have returned a fair proportion of the profits to the business, with the results shown effectively by the present condition.

Production planning on the whole has attained the flexibility of conception which has characterized the pioneering free thinkers of American social and industrial progress.

Within the past two years two factors have stimulated this condition. One is the development of pyroxylin body finishes and the other is the changed attitude of the machine tool and equipment builders. A great share of the industry's present favorable condition can be ascribed to the pyroxylin finish, because in addition to making body finishing an established part of a smooth flowing production program, this development has centered attention on the body. For a long time, engineers, production men and nearly everybody concerned "ducked" the body question religiously, largely because of the unknown quantities present in every body shop. Wood working and metal departments were accountable factors and assembly could be handled, but the holy horror of the finishing shop, particularly under conditions of quantity production in colors, stunted any positive enthusiasm for the whole scheme of body production.

When production men found that a way out of the impasse of the finishing department was opened up by lacquers, interest in body production and enthusiasm for every detail of body manufacture returned with a rush. And now, bodies both closed and open are poured through production lines just as are the connecting

rod and crankshaft. Hand fitting with tin snips and saws has been replaced by assembly jigs and interchangeable wood and metal parts, and sub-assemblies of roofs, backs and sills drop into place. The finished product compares more than favorably with the custom work of ten years ago and the price is less than that of the fair production jobs of three years ago.

In the machine tool field, several makers have departed from the time-worn prejudice that a good machine tool consists only of cast iron, steel bar and bearing metal. And what is more, some of them have ceased to sell this combination, but rather are selling a production service. Time was when machine tool builders looked upon even the electric motor as something outside of the traditional realms of their forefathers' practice and therefore as a thing to be shunned. And all of this time the electric motor was better than any machine tool. In view of the machine tool developments of the past year it seems that the electric motor has arrived and along with it have come the magnetic sizing and control devices and hydraulic and pneumatic feeds and controls.

With the introduction of these, in addition to the continued development of cyclic types, the machine tool has become a plastic thing which fits into the technique of the current production planning department. While it is generally admitted that for a long time automotive production men were pointing the way to machine development, the situation now is reversed and the more far-sighted, both mechanically and economically, of the machine tool builders are engaged in a constant campaign of development of new and improved forms of machining service and this is having a good effect.

SUMMING up the 1925 production picture, Mr. Carver says in this article that—

"On the whole, 1925 as related to automotive production has not been remarkable for the development of new processes but rather has been a period of more thorough and flexible utilization of the methods and means at hand.

"Machine tool builders show progress in amplifying existing types of equipment in the direction of elimination of direct charges and greater economy of operation and floor space.

"The journey away from the old-time general contract shop conception of production has been necessarily slow, but progress is bound to accelerate now that more and more of the machine and equipment people and automotive production men of the advanced type are acquiring a common viewpoint."

Individual Electric Drive

During the past year the unit drive or individual electric motor has been a feature of all of the medium and larger sized machine tool developments. Knee type and vertical milling machines have been the outstanding figures, followed by the internal grinders. The new Heald internal grinder also incorporates a hydraulic feed for the wheel head and carries its own generator for producing current for the control and sizing mechanisms. The new Bryant grinder, which retains the features of the overhead carrier bar and pilot strip at the back, but in which the outboard support for the overhead bar has been eliminated, also is designed for individual motor drive.

Hydraulic feed is the feature of the later designs of Ingersoll milling and drilling equipment, while Oilgear and Waterbury hydraulic units are incorporated in the latest broaching machine developments. The new Detroit centerless grinder and the Cincinnati heavy duty cylindrical grinder have individual motors for each function. These are typical samples of the present trend which makes machine tools almost as mobile as men and ultimately will have a considerable effect on the lighting of the plant.

Appreciation of the elements of operating time is shown by another trend. The Bullard Machine Tool Co. has developed a motor operated chuck in order to reduce the loading time to within the limits of the time of the cyclic advance of the machine. Operator fatigue is reduced accordingly. The latest New Britain automatic is fitted with air chucks which accomplish the same purpose and allow this machine to operate at maximum capacity on brass and similar work. The Vertical Automatic, made by the Cincinnati Engineering Tool Co., opens and closes the work fixtures automatically as they enter and leave the loading station.

Jig and Fixture Equipment

This tendency in the design of the tools proper has been reinforced by a similar consideration of jig and fixture equipment. Cam and eccentric clamping devices and equalizers are used to a greater extent and moreover are designed by the machine tool builder with as much care as are the tools themselves and with the same appreciation of rigidity and continued operating accuracy. On the whole, oiling systems and anti-friction bearing installations have become parts of the machine tool builder's book.

Equipment for drilling groups of small holes along with reaming, tapping and similar operations is not yet on a par with the developments in the milling and larger drilling fields. Shaft turning lags somewhat further behind the modern procession and, while cylindrical grinding led the way at one time, it has given way to the recent internal grinder and milling machine developments and from the standpoint of production operations has been supplanted in many instances by centerless grinding. As long as one man's time is required for the operation of but one wheel on one surface, the room for development is apparent, although the proposition of applying two or more grinding wheel spindles to a machine which will go through the average factory door is not the simplest.

One of the unusual recent developments in the machine tool field is the Kobert Electric Forging and Riveting Machine, which is produced by the National Equipment Co. of Springfield, Mass. This machine combines the heating and striking elements for small forging, upsetting and riveting operations. The mechanically operated ram carries a copper heating element which contacts with the top of the work. The latter is held in dies which are wired with the other line of the electric circuit, the bus bars being shown. When the piece reaches the correct predetermined forging heat, manipulation of the control lever shifts the upper heating element out of the way and brings the ram into position and the downward stroke follows immediately. For chain riveting and similar jobs the operation of the machine is made continuous.

One of the immediate applications of this machine is to the joint between rod ends and cables in four-wheel

The Contents and Where to Find Them—

Production and Factory Equipment Issue

THIS issue of **Automotive Industries** has been designed to cover the outstanding developments in current automotive manufacturing practice. It begins with a series of special articles. These are followed by complete reports and summaries of two conventions and one show held last week which were of direct interest to automotive production executives. The four parts of the issue are:

SECTION I

Special articles by staff editors and outside authorities on the following subjects:

Production Progress as Reflected by 1925 Profits
Material Handling Equipment in Automotive Plants
Plant Illumination: Lighting the Way to Increased Profits
The Human Side of Modern Production: Wage Payment Systems
Progress in Body Construction
Welding Automotive Parts
Washing and Cleaning Processes
Oven and Drying Equipment

SECTION II

Annual Production Meeting of the Society of Automotive Engineers with a complete report of each session and digest of papers. Page 524.

SECTION III

The National Steel Exposition and Convention of American Society for Steel Treating. Page 548.

SECTION IV

General news of the industry. Page 554.

brake linkage. Link and silent chain possibilities have been mentioned already. Unlike materials may be joined, as in the case of a bronze valve head on a steel shank. The valve head is bottom drilled so that it just slips over the stem. The two are then set in the die and heated and struck. The top of the steel stem mushrooms out into the metal of the head and forms a practically indestructible joint. Cap screws can be made by upsetting threaded studs and the rivets or pins set in such parts as pliers. The machine is not intended for welding but is a self-contained specialized forging unit.

In the metal pattern field, the Electro-Chemical Pattern & Manufacturing Co. of Detroit has introduced an electro-chemical method of producing metal pattern equipment in any quantities from the wood master pattern. Contrary to customary practice, the master pattern is given the same shrinkage as the production equipment and can be reproduced at any time. The production pattern metal is copper faced and lined with white metal and requires practically no dressing on the working surfaces.

Duplicates of Master Pattern

Every production pattern is an exact duplicate of the master pattern and cope and drag plates can be produced interchangeably without regard to the location of the parting line. It is stated that copper forms an ideal metal pattern material. The metal in this instance is not cast or forged but is deposited electrochemically and its hardness and toughness increase with use due to the cold working action of ramming the sand in the mold. Depending somewhat on the nature of the piece, metal pattern equipment which is absolutely interchangeable can be turned out for 10-80 per cent less than the cost under the older methods. An unusual feature developed by this company is an estimating chart upon which patterns of moderate size or tracings and templets can be laid and their exact price figured directly. This is an important step in the direction of eliminating guess-work and waste.

No Remarkable Developments

On the whole, 1925 as related to automotive production has not been remarkable for the development of new processes but rather has been a period of more thorough and flexible utilization of the methods and means at hand.

Machine tool builders show progress in amplifying existing types of equipment in the direction of elimination of direct labor charges and greater economy of operation and floor space.

The journey away from the old time general contract shop conception of production has been necessarily slow, but progress is bound to accelerate now that more and more of the machine and equipment people and automotive production men of the advanced type are acquiring a common viewpoint.

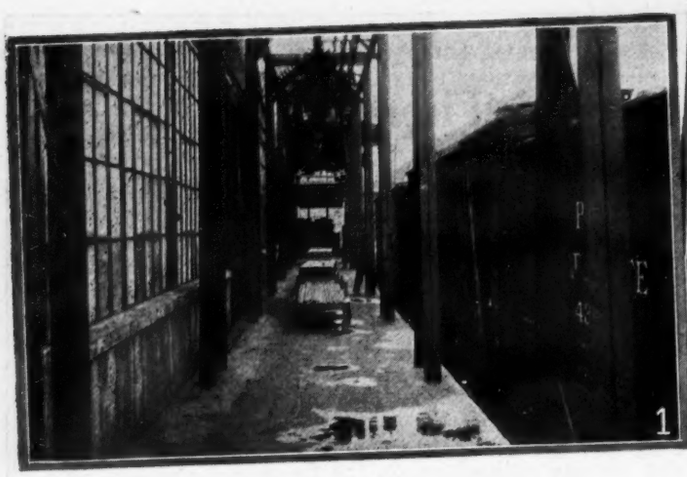


Fig. 1—Monorail and electric hoisting and conveyor car used at unloading dock of Ternstedt plant 14.
Fig. 2—Same car operating on traveling crane covers full area of storage room and delivers stock to first machine operations

Conveyance of Materials—

Varying Degrees of Perfection Reached in Systems Now in Use

Conveyors alone, however, not solution of problem which confronts manufacturer. Arrangement of equipment is first consideration. Better method needed for unloading incoming material from cars.

By W. L. Carver

HERE are two phrases drawn from widely different sources, but both fundamentally pertinent in the discussion of handling materials within the automotive plant:

"Never touched by hands," is one.

The other is, "When a laborer is carrying a piece of pig iron weighing 92 lb. in his hands, it tires him about as much to stand still under the load as it does to walk with it. A man, however, who is standing still under load exerts no horsepower whatever."

"Never touched by hands" has become almost a slogan in the advertisements referring to cereal foods and similar articles. While it is intended primarily to emphasize the element of cleanliness in manufacture and does this in pointed fashion to the manufacturer in any line, it should convey volumes on the subject of handling material.

The second phrase is taken from "The Principles of Scientific Management" by Frederick W. Taylor and refers particularly to his study of the movement of pig iron in the hands of yard laborers. This study resulted in raising the amount of pig iron loaded into cars from 12½ to 47 long tons per day per man. While this pig iron was handled in the most elemental of ways, by the simple expenditure of human energy, Taylor enunciated a truth which applies equally well to all methods of handling material.

Visualize a yard laborer standing perspiring with a 92-lb. pig in his hands and in the process wearing himself out and producing nothing. Transformed to modern automotive practice, the same picture can be described by "The conveyor is an asset only when it is conveying to capacity."

Where the Handling Problem Lies

Somewhere between these limits lies the handling problem of the modern automotive plant. Some of the small parts specialists have come very near the condition suggested by the first phrase while other parts manufacturers depend largely on the elemental method. Manufacturers in both the vehicle and parts fields have rebounded from ultra-refinement and in other instances have struggled along with handling methods which were too apparently crude for the production conditions. Bolts, cap screws, etc., are produced with a minimum of handling, while at the other end of the scale, large castings and forgings are produced in many places with a maximum of elemental handling.

Two factors loom large in the material handling problem of the modern automotive plant, particularly where a car or truck, or both, in one or more models is produced almost entirely within the parent plant. The first is the diversity of materials entering the plant and the second is the requisite size of the plant.

Fig. 3—Electric lift truck and special skids delivering four Packard rear axles. Fig. 4—Fordson tractor with one man handling fourteen trucks at River Rouge

In many quarters and sometimes within the industry itself, the apparent complexity of the modern automotive vehicle is not appreciated. A hurried analysis of the records of the average purchasing department will reveal 200 and more classifications of material and ordinarily a greater number of sources of supply. Materials range all the way from cotter pins to completely machined small parts, electrical units, delicate instruments, axles complete and partially assembled, frame members, body fabrics, plate glass, seat springs, engines, bar stock and countless other items.

Great Areas Covered by Plants

From the other angle, the plant area of only a moderate producer of cars and trucks easily can exceed 20 acres and from this base can extend to several hundred acres for the larger producers and up into the thousands for the few largest manufacturers in the low priced field. Single story saw-tooth construction involves a considerable horizontal spread in the moderate plant with many process points remote from the receiving platforms. In turn the distances from the process lines to the shipping platform are correspondingly great. Furthermore, the older plant sites often do not allow for a multiplicity of switching spurs and newer locations are subject to the same restrictions.

Some trend away from single story structures is evident, particularly among larger plants. In these cases, the complexity of horizontal material lanes is aggravated by numerous vertical transfers. Where the handling problems of many industries, such as paint and varnish and cereal, are simplified by multi-story buildings, it does not seem that this construction simplifies automotive practice. However, land investment and maintenance and operating charges probably offset the disadvantages.

With this picture of the modern automotive plant in mind, it is easy to comprehend that 90 per cent of the effort involved in building an automobile is devoted to handling and but 10 per cent goes to actual process effort. According to Max Sklofsky, chief engineer of Deere & Company, the ratio of handling effort to process effort in the foundry will exceed these figures and can run as high as 96 per cent for handling and but 4 per cent for actual process.

These ratios refer to effort rather than labor hours or payroll. However, they demonstrate that the handling of entering materials, work in process and the two products, finished units and scrap, constituted one of the major manufacturing problems, if not the greatest.

Due to the complexity of product and plant, there is no cure-all for the material handling problem, and contrary to the growing opinion the solution is not tied up in the term conveyors alone. In fact, some plants have too many conveyors at the present time. Just as many engineers concentrated on power plant and chassis design for a number of years at the expense of body development, so have many plant engineers and master mechanics centered their attention on process or machine lines to the relative neglect of feeder lines.

A small amount of handling equipment properly arranged rather than elaborate conveyor systems is the hall mark of a well designed plant. Materials should move step by step from the point of arrival to that of departure. But as all manufacturing, like all engineering, is a compromise between the ideal and actual commercial necessity, the overhead of material handling effort is forced upon the plant.

Forethought in the arrangement of plant and machine lines will eliminate much of the handling and the incidental equipment expense. For the balance, the picture of material handling equipment is about as complex as that of the plant which has been outlined in earlier paragraphs. Therefore, some specific material type of handling equipment is best suited to any particular job. In every case, the type chosen should be such that the maximum horsepower which involves the elements of weight per part, distance traveled and time, is obtained at the lowest cost when investment and return are considered.

High Price Per Horsepower Hour

Beginning at the bottom of material handling facilities, one man can deliver about 1 hp.-hr. in his day's work. Therefore the manufacturer pays from $4.50 to $6 per horsepower hour, which is an exorbitantly high price. Basically this is the reason why men do not carry chassis down the assembly line on their shoulders. Henry Ford has stated that he aims to employ one man for every available horsepower at the power plant. Therefore in the abstract, in addition to his own, every man will have command of eight additional horsepower hours, assuming an 8-hour working day.

This constitutes the reason for all of the varieties of mechanical handling equipment, but also is a negative answer to conveyor equipment between many machines and is a howling protest against the methods of handling incoming material at the majority of plants. In spite of elaborate assembly lines and conveyors throughout the shop, the majority of incoming material is unloaded

from incoming cars and trucks by hand. Somebody will begin to make a study of box cars that will bring about some profitable changes in the containers for incoming materials.

Why should not the plant which is in regular rotating production in considerable volume receive parts such as crankshafts, electrical units, etc., in collapsible containers which can be delivered directly to the point of application in the assembly line or the first operation in the machine line? And why should not these containers be shipped on flat cars just as they are on platform trucks? True, the railroad is holding the investment bag at present, but this industry never has been chary of spending money for equipment which facilitates operations.

Operator Can Handle Work

As to handling materials between machine operations, there is need for roller conveyors or slides when the parts are heavy and bulky, but ordinarily with the type of machine equipment used at the present time this work can properly be handled by the operator. Other exceptions can be made when highly developed cyclic machines are used, in which case operation is so rapid that every facility must be given the operator in order to allow him to load each station as it passes the front of the machine. Otherwise operators can pass parts weighing up to 40 lb. without fatigue which will offset the normal capacity of the machine. Benches or tables of somewhere near the height of the machine bed will facilitate operations under these conditions.

An excellent example of modern methods of handling material is provided by plant No. 14 of the Ternstedt Manufacturing Company. Unloading, storage and delivery to the first operation are accomplished with a minimum of handling. Bar stock from the incoming cars is transferred to steel racks which are placed in the correct position on the unloading dock by a cab-operated overhead monorail crane unit. When racks are loaded they are picked up by the overhead unit and pass over a built-in scale arrangement. The overhead track which runs along the unloading dock as shown by Fig. 1 connects in turn with a bridged traveling member which runs the length of the rough stock department, as shown in Fig. 2.

Stock Delivered to Machines

Storage racks are designed to allow piling one above the other and the sling which is used with the hoisting unit clamps the bar stock while being moved. The clearance for the cab determines the height of the stacks. As shown by Fig. 2, the machines for producing the first operations on various parts made in this building are located along the left side so that stock can be delivered in large unit quantities from the receiving dock or the storage racks with no element of laborious handling. No conveyors are used after the first operation and to all intents and purposes, parts are passed from machine to machine with lift trucks being used for relatively long hauls to other departments.

Smooth material flow is the outstanding characteristic of the new Jewett plant where the engine plant is located at one side of the chassis assembly line and the various feeders for bodies, tires, sheet metal parts and hardware are placed on the opposite side. Frames enter the lower end of the plant and are conveyed to the head of the plant in parallel to the final assembly line, being completely assembled and painted en route. While nearly every form of conveyor is used liberally, a great share of the handling is accomplished by the station to station method, as equipment is arranged so that parts travel naturally from one machine to the next. Cross lane feeders of this nature bring parts out to the most advantageous point in the main conveyor lines.

Types Fall Into Groups

Although the different types of material handling equipment are legion, the various types used at present fall into a rather logical scheme which has its basis in the conveying ability of one-man power. Referring again to the quantity, one hp. hr., which is about the maximum output of one man per day, a basis for adopting one type of conveyor equipment may be arrived at. By making a comparison of the horsepower input with the horsepower output plus the investment charges, a key to the most desirable type of handling equipment is offered. It must be remembered that any means of moving material is not a producer but a form of transportation service. Therefore the type of equipment to render a specific service must be determined by balancing investment against operating charges. Offhand, this process would seem to justify only gravity equipment, but in view of the service element, thorough analysis will justify the most expensive conveyor equipment for some installations.

Another angle in the selection of equipment may be adduced from the policies of some of our wartime efforts. In order to be considered, a piece of mechanical equipment had to replace one man at a cost which did not exceed a certain maximum allowance, which is another way of attaching value to one-man power. Analysis of many smaller establishments should produce a figure of similar nature for the evaluation of transportation service at the correct balance between capital investment and operating charges.

Three Main Classes

As related to automotive plant material handling, means used ordinarily fall logically into three classes: First, purely service equipment for transferring material from the point of arrival to the process line or stock room. Second, equipment for transferring parts from one stage to the next of the process line. This class depends upon gravity or man power for actuation and requires no mechanical operation. Third, power operated equipment for transferring material or parts from one station to the next. It will be noted that the first class comprises both power-operated and the simple type of equipment. This class is not basic but is placed first as it falls into the natural routing of incoming material. These groups follow:

Group One

Service equipment for delivering material from point of arrival to point of application or first operation.

1. Man power only, carrying bag, basket, box or single piece.
2. Man power with wheelbarrow, baggage truck or truck.
3. Man power with elevating truck with skids incorporating boxes, racks, etc.
4. Electric elevating truck with skids. Also including high lift elevating equipment, jib cranes, etc. Elevating lumber trucks.
5. Gasoline or electric tractor with train of cars or trucks which may be equipped with special racks, etc.
6. Overhead monorail with or without power operation.
7. Traveling crane with slings, racks, magnets, etc. Used in conjunction with extended decks in multi-story buildings.
8. Elevators, platform type or continuous chain.

Group Two

Handling equipment for process lines involving no mechanical operation.

1. Man power only, passing parts from station to station.

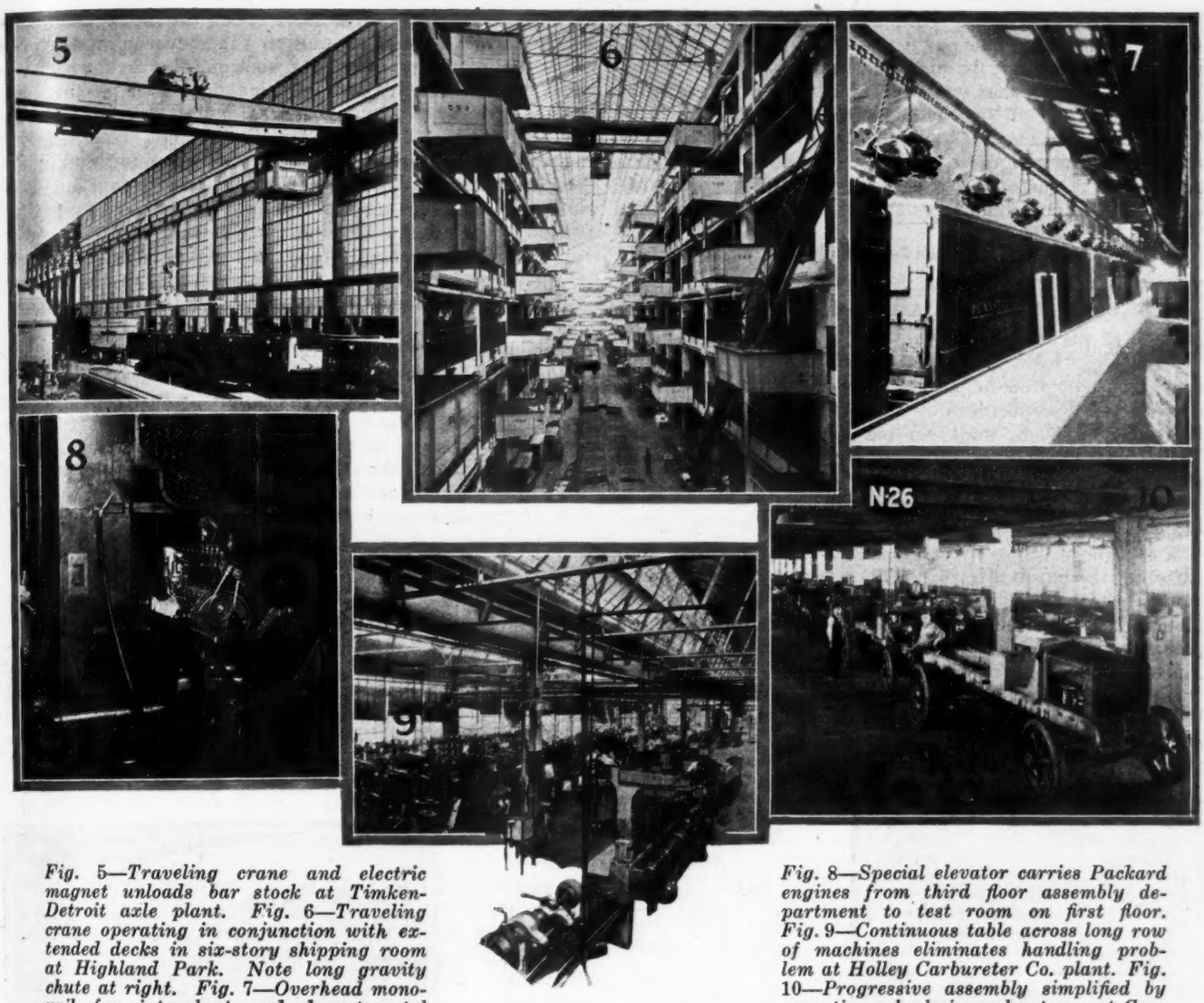


Fig. 5—Traveling crane and electric magnet unloads bar stock at Timken-Detroit axle plant. Fig. 6—Traveling crane operating in conjunction with extended decks in six-story shipping room at Highland Park. Note long gravity chute at right. Fig. 7—Overhead monorail for interplant and departmental transportation at Ford plant

Fig. 8—Special elevator carries Packard engines from third floor assembly department to test room on first floor. Fig. 9—Continuous table across long row of machines eliminates handling problem at Holley Carbureter Co. plant. Fig. 10—Progressive assembly simplified by mounting wheels in early stages at General Motors truck plant

2. Tote boxes. (A) Small which are handed from station to station. (B) Large, which are moved on plain or elevating trucks.
3. Slides or planes on which parts are placed directly or in carriers.
4. Chutes made of plain structural shapes, wood or sheet metal.
5. Racks on casters, etc. Vehicle proper upon its own wheels or auxiliary wheels. With or without guiding rails.
6. Roller conveyors.
7. Overhead monorail, using hooks, etc.

Group Three

Mechanically operated equipment used in conjunction with process lines.

1. Jib crane or overhead monorail equipped with air or electric hoist.
2. Pneumatic pusher in conjunction with wheeled carriers and guide rails.
3. Belt conveyor.
4. Continuous chain conveyor.

This type is capable of almost infinite variation. A few representative applications are: Separate guide rails and slides, movement transmitted to part or vehicle by hooks or dogs; parallel chains connected by flat sections to form continuous moving table; adapter brackets mounted on parallel chains; rods mounted between two chains for carrying parts by means of hooks; overhead monorail loop equipped with hooks, etc.; interplant or department monorail; A-type and hump oven installations.

Several illustrations of the types outlined by these three tables have been taken from various automotive plants. In some cases, special features are incorporated to enhance the inherent advantages of the particular system of handling material. To illustrate class one are the following:

Fig. 3 shows the use of an electric lift truck in the Packard plant. Rear axles which are machined, assembled and tested in a separate building are delivered to the chassis assembly floor at the rate of four per haul by the use of the truck and the special caster equipped skids.

The multiplication of one man power is indicated clearly by Fig. 4, which is taken at the Ford River Rouge plant. One man with a Fordson tractor is moving 14 hand trucks, each of which would be a good load for one man. When the increase of speed is considered, one man plus a tractor are doing the work of about 50 laborers in this particular class of work. The Ternstedt pictures already referred to are excellent examples of the use of both monorail and traveling crane systems. Combination of these with the power unit traveling on both systems offers an unusual opportunity for the multiplica-

tion of one man power. Outside of the work of unloading cars, this one man performs all of the work of both storage and delivery to machine lines. Another traveling crane installation is shown in Fig. 5, which is taken from the plant of the Timken-Detroit Axle Co. Five heavy bars are moved simultaneously by the use of an electric lifting magnet. Incidentally, while flat or gondola cars are customary practice in bar stock shipments, this illustration emphasizes the value of open top cars.

A Ford Traveling Crane

The use of a traveling crane in a six-story building is shown by Fig. 6, which is a portion of the Ford Highland Park plant. Boxes, racks and skids are picked up from the platform and lifted to the correct floor where they are deposited on extended decks. The advantage of collapsible containers or unit containers such as are used by the U. S. mail service as part of a material handling scheme such as this are almost self-evident. One man with one crane can move great quantities of material per day, but how many are required to get the same material out of the cars?

A section of the overhead monorail system at the same plant is shown in Fig. 7. This is but one of several similar lines which run through a great portion of the plant. This system is an aspect of a high production plant and verifies the necessity for balancing equipment investment and operating charges.

In Fig. 8, an unusual elevator installation is illustrated. In the Packard plant engines are assembled on the third floor while the test room and final assembly department are placed on the first floor. On the upper floor the conveyor lines lead around to the elevator shaft. The elevator platform carries a section of track which indexes with the line on the third floor and a short section on the first floor. From this short section a transfer car delivers engines to the various rows of test equipment. Due to the production element, which is moderate, this elevator equipment represents a lower balance between investment and operating cost than would a continuous type.

In the second class, the carbureter production line at the Holley Carbureter Co., as illustrated by Fig. 9, provides an outstanding example of the advantages of passing parts from station to station. Practically all operations on the entire carbureter are designed for application to drill press practice. A single long table extends over a number of drill press frames with room for one man to stand at each station. Each man performs his particular job and in the process of loading and unloading his jig takes parts from his left and passes them to his right. Therefore a piece moves from one end of the line to the other with no expense for handling.

Same Type for Heavy Parts

Although it may seem that this type of operation is confined to small parts, practically the same type of operation is used in the plow shop of Deere & Co. at Moline, Ill., where bulldozers, furnaces and various heavy machines are involved. These are lined up in what seems a rather irregular arrangement until the progress of a single piece is followed through the shop. Engine fans are produced by a similar scheme at the plant of the Automotive Fan and Bearing Co. at Jackson, Mich.

Typical installations in Packard, Franklin and General Motors plants

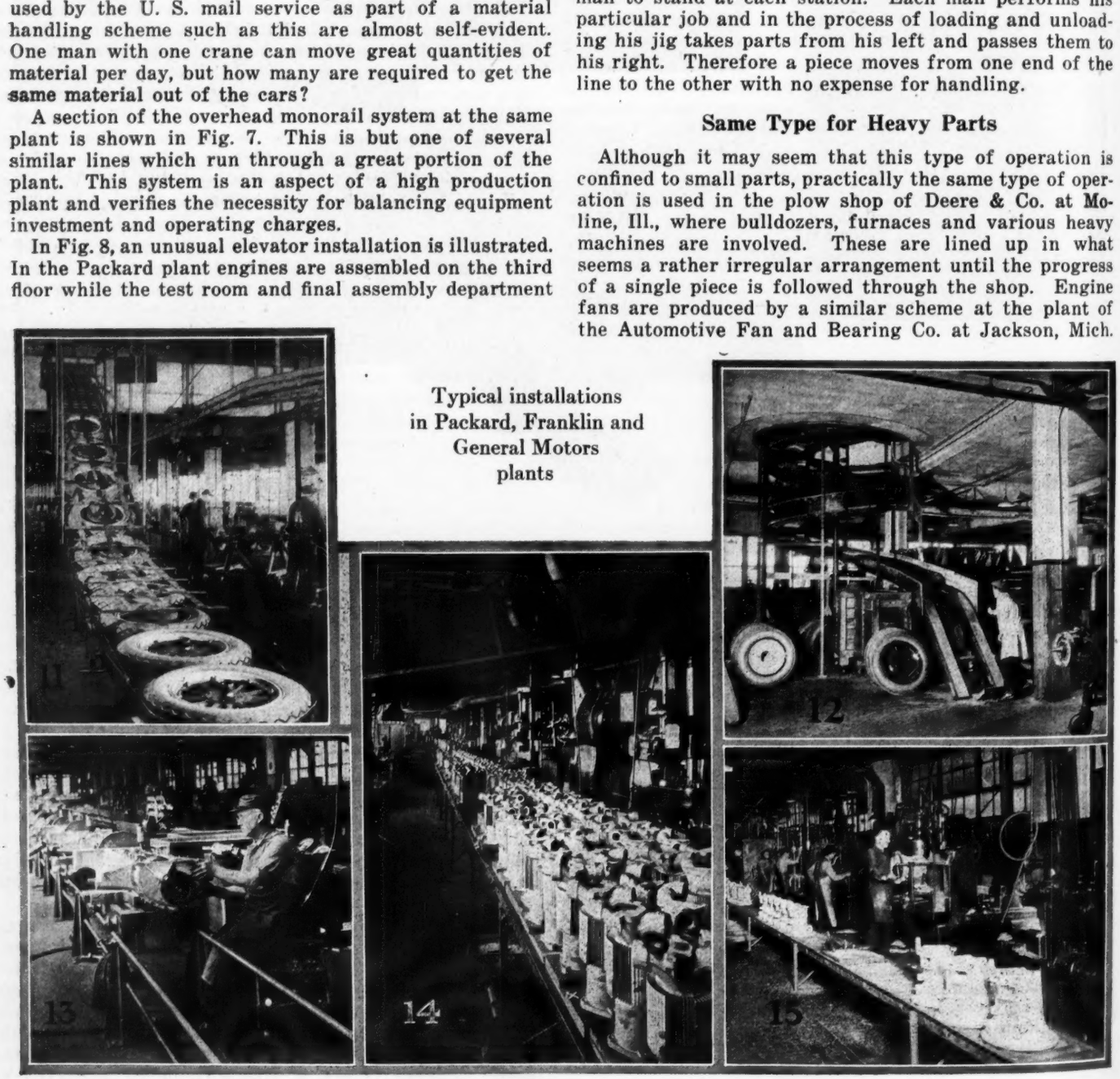


Fig. 11—Typical chute and overhead monorail system in General Motors truck plant. Fig. 12—Spiral chute conveys wheels to Packard final assembly line. Fig. 13—Parallel tracks and wheeled carriers are used in Packard engine assembly. Fig. 14—Franklin cylinders are grouped on roller conveyors. Fig. 15—Roller conveyors used in transmission case machine line in Franklin plant

Here, again, the arrangement of the shop does not appeal immediately to the eye as the usual regular aisles are conspicuous by their absence, but machines are grouped so that parts move from one to the next with no intermediate handling and in many cases one man operates two or three machines.

It would seem that one of the greatest obstacles to this method of manufacture is the preconceived picture of the shop which is based on the old-time departmentalized job shop where drill presses, shapers, lathes and milling machines are lined up like so many companies of soldiers. This arrangement was fine for the job shop that handled almost any type of work and depended upon the specialized skill of the corporal of each company, but it is entirely outside of the scheme of continuous manufacture.

For the plant in limited or moderate production, progressive assembly which involves moving assembled material from station to station can be accomplished readily by mounting the vehicle upon its own wheels in the early stage of assembly. Fig. 10 illustrates this method at the plant of the General Motors Truck Company. Fig. 11 illustrates the liberal use of chutes and overhead monorail equipment in the same plant. The chute which is equipped with rollers brings assembled wheels and tires down from the second floor to the unit assembly floor. The overhead system is utilized in the assembly of axles in this case and for the purpose of delivering completed units to the assembly line. The overhead system has the advantage of being up out of the way and therefore does not tie up any floor space except when engaged in the actual transportation of parts. A spiral wheel chute as incorporated in the Packard assembly department is shown in Fig. 12.

Engines Moved on Track

The use of slides or track is illustrated in Fig. 13, which is taken from the engine assembly line at the same plant. Steel bars are mounted in parallel on cast iron pedestals to form a track which extends the length of the engine assembly floor. Wheeled cars are used at the head of the line, while the case is upside down and wheeled brackets then carry the engine to the elevator, as shown in Fig. 8. At the Chrysler Six plant chutes are utilized to move pistons through the machine department. They are made of light structural steel and inclined so that these parts roll from machine to machine.

Two examples of roller conveyor equipment as applied to a process line are shown in Figs. 14 and 15, both installations at the H. H. Franklin plant. In Fig. 14, eight air-cooled cylinders are set on a common skid made of wood. In Fig. 15, transmission cases move directly on the rollers as the outline of the bell housing allows plenty of stability. Some new machines are arranged so that the conveyor line is intercepted by a slide which eliminates the element of lifting between the conveyor line and the table of the machine. However, some portion of man power handling is involved usually between the conveyor and the machine. For moderate production this is justifiable and some figures prepared several years ago by Frederick W. Taylor throw an interesting side light on this method. By experiment, he and his associates determined that a man handling units weighing 92 lb. can be under load during 43 per cent of the day, while a man handling units of 46 lb. can be under load 58 per cent of the day. As the weight grows lighter a point is reached finally where a man can be under load for the entire day without injurious fatigue. This law is utilized in the handling schemes of some of the larger plants, but apparently has not been given full weight in some of the smaller plants. Appreciation of the law will tend to simplify methods and means in some quarters.

In this section, no mention has been made of the block and tackle or chain hoist, although both of these continue to occupy a place of real utility. However, they are becoming rarer in the usual production line, with the exception of some of the limited producers in the tractor and truck field. The chain hoist is used very generally in maintenance work and in the tool and die rooms.

Air and Electric Hoists

While the third class of equipment has not been subdivided into many classes, it is on the whole subject to almost infinite variation. Air and electric hoists play prominent parts in almost every process line where parts of any appreciable weight are handled. Several of either are found at many points in practically every final assembly line and are used liberally in machine lines, particularly with milling machines. An unusual application of the air hoist is shown in Fig. 16, which is a section of the Packard engine assembly line. In this arrangement, which was described in detail in AUTOMOTIVE INDUSTRIES of March 6, 1924, an air hoist in conjunction with an overhead monorail is utilized to carry cylinder blocks from the storage table across the aisle to a point immediately above the assembly line. As the carrier descends, pilot bars guide the block down over the pistons which have been secured in correct alignment. A foundry vibrator placed on the carrier supplies the agitation required to prevent sticking.

A typical application of the electric hoist in the same plant is shown by Fig. 17. Bodies are assembled on the second floor and carried over a well by means of an electric hoist and overhead monorail and then lowered into position on the chassis which move along the first floor. This figure also shows a simple application of the continuous chain which is in constant motion. Chassis are mounted on castered carriers which are guided on rails. The chain is set midway between the rails and above the floor. Movement of the chain is continuous and the carriers are set into motion by hooks which connect the carrier frames to links in the chain.

Between two and three years ago the pneumatic pusher made its appearance and became popular immediately, particularly in the body and paint shop. The application of the pusher to the body storage lines of the Paige-Jewett shop is shown in Fig. 18. Each body is mounted on a wheeled car which is guided by a channel and a flat rail. The pusher operates a long bar with carrying dogs which engage with the frames of the carriers. Operation of the valve at the pusher advances each of the carriers one stage while the reversal of the valve returns the pusher bar into position for the next stage of advance. This type has found rather liberal application to the simple drying booths used for pyroxylin finish.

The Chain Conveyor

The chain conveyor is used in a multitude of ways. So many, in fact, that no attempt can be made here to discuss basic types. However, a number of typical installations with brief discussions of unusual features are included. Fig. 19 shows the final assembly line at Highland Park, which is one of the oldest lines in the industry. The chassis slides on rails, which contact with the front and rear axles and is driven by dogs on the chain which is contained within the frame work of the line.

One of the most recent conveyor developments by the Ford organization is the loop enameling line at the Canadian plant, as shown by Fig. 20. A complete overhead loop is utilized in conjunction with a hump or

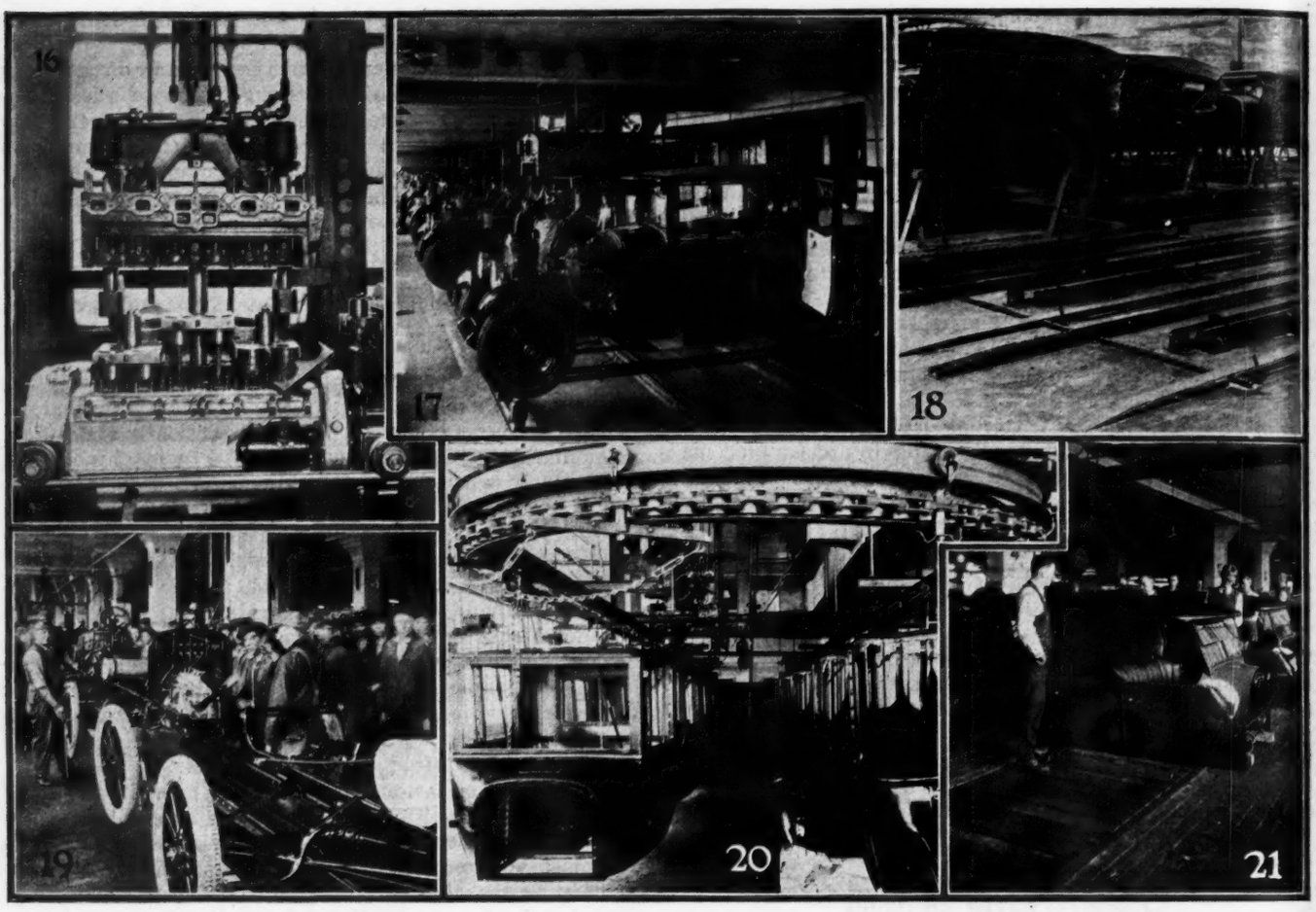


Fig. 16—Unusual application of air hoist to engine assembly in Packard plant. Fig. 17—Electric hoist places Packard bodies on chassis which are advanced by continuous chain. Fig. 18—Pneumatic pusher advances bodies in Jewett storage line. Fig. 19—Ford chassis assembly line, one of the earliest continuous installations. Fig. 20—Recent Ford conveyor development. Horizontal loop and U-shaped oven reduces paint shop work to minimum. Fig. 21—Moving floor arrangement facilitates work in Franklin continuous body trimming line

sealed oven which is U-shaped in the plan view. Therefore bodies which are flow-coated at the entrance to the oven return to the same point for the succeeding coats. In this way one small gang of men does all of the work of enameling and handling is reduced to the very minimum. Due to the saving in space and handling charges and the fact that all of the chain is busy all of the time, this installation is an outstanding example of determining the best balance between investment and cost of service.

Two illustrations from the H. H. Franklin plant show unusual applications. In Fig. 21, parallel chains are set into a deck and joined by planking to form a moving floor in the final stage of the progressive body trimming line. This arrangement allows men to work safely and easily at every point on the body, particularly during the mounting of the top. Fig. 22 shows the application of parallel chains to a progressive transmission assembly line. The parallel chains move cast iron carriers which return to the head of the line in the space underneath the structure, which is placed at bench height.

Typical Chain Installations

Three illustrations from the new West Warren plant of the Paige Detroit Motor Car Co. illustrate novel combinations of typical chain installations. Fig. 23 shows the tail end of the frame assembly and painting line where frames descend from the overhead ovens where they have been moved by parallel chains to another chain, which is arranged to form a moving table of bench height. Fig. 24 shows a chain in conjunction with an overhead monorail which picks engines up from the engine shop and carries them around through the spray booth and then through a drying oven, which is below that for the chassis and finally out to a storage line which parallels the two final assembly lines. Fig. 25 is the so-called bull-ring which is used for engine assembly in the same shop. This is a closed horizontal loop which is set in the floor, the first and last operation points being located near each other.

Nickel-Plating Conveyors

Fig. 26 is an installation of chains which are parallel in the vertical plane. Each master link is fitted with two rollers which drive vertical bars. The vertical bars are moved up and down by inclined strips serving as cams. The lower ends of the bars carry hooks for the support of small parts which are completely copper and then nickel plated. Spring operated shoes which contact with a bus bar are placed at the upper ends of the vertical bars. This installation is in the plant of the Walden-Worcester, Inc., and approximately 50,000 wrenches are plated per day with a very low labor expense. Two or three men do all of the actual work of plating.

In Fig. 27 we have an installation which performs the same function as the equipment in Fig. 26 and is built by the same company, but which is of more recent design and embodies a number of improvements that make for

Fig. 22—Continuous chain carrying special assembly fixtures in Franklin transmission assembly department. Note return channel underneath structure. Fig. 23—Combination of overhead conveyor and moving table at Jewett plant. Fig. 24—Overhead conveyor which is placed under chassis drying oven at same plant. Fig. 25—Bull ring arrangement at Jewett plant. Fig. 26—Continuous nickel-plating line at Walden-Worcester plant, plating 50,000 parts daily. Fig. 27—The latest type of full automatic conveyor for electro-plating work. Fig. 28—Continuous pouring line at foundry of Whitehead & Kales. Fig. 29—Sand is reconditioned and delivered to molding outlets by continuous conveyor equipment in same foundry

greater economy of maintenance. This full automatic conveyor carries out the complete treatment cycle of an electroplating process. The work is mounted on suitable racks, placed on the workhangers at one end of the machine, and then carried automatically through the different cleaning, rinsing, pickling, plating, rinsing and drying treatments and taken from the machine at the unloading station. The entire process is predetermined in the design of the machine. Machines of this design are used in the plants of the Ford Motor Co., the Off'N'On Chain Co., the Hyatt Roller Bearing Co., Stewart-Warner Co., and the Ternstedt Mfg. Co.

Figs. 28 and 29 show the application of continuous handling methods to the foundry of Whitehead and Kales. Fig. 28 shows one end of the continuous molding table which carries the process from the empty flasks clear through the pouring station and then through the knockout and finally around to the beginning of the process again. While no chains show in Fig. 29, the sheet steel structure incloses several which take sand from the knockout or new supply and pass it through a reconditioning process and finally deliver a supply of conditioned sand to various outlets. A traveling crane equipped with an electric hoist is used to handle molds and ladles.

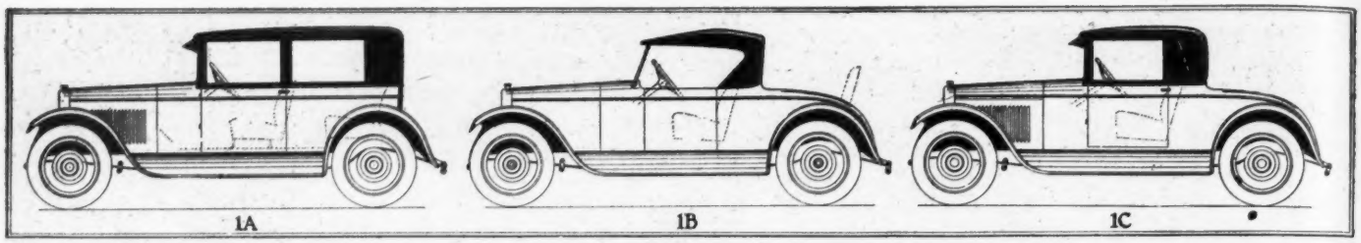


Fig. 1—Three predominant types of body now in production: (1a) Coach; (1b) Roadster; (1c) Roadster-Coupe

Standard Bodies Are Now Produced at One-Third Pre-War Cost

Development of metal stamping process and quick-drying pyroxylin finishes have brought about radical changes in production methods. Installation of conveyor systems has also speeded up operations.

By George J. Mercer

THERE are periods in the progress of automobile body development that show definite turnings; these are presaged by rumors of a more or less indefinite character, and then we have the realization that definitely marks the beginning of a new style or construction era.

Right after the great war, Hudson launched the coach and the selling slogan, "a closed body car for an open car price," really brought to a focus the growing tendency to make closed bodies the selling feature or drawing card to attract automobile purchasers.

History in the body business since that time has been centered around manufacturing possibilities rather than style or design; individuality in bodies has become less a factor in the purchaser's mind. It is true that there is and will be a substantial number of car owners who want distinctive looking bodies that are not confused with the average car on the street, but to the great mass of users and owners the automobile is a means of transportation and its utility and service features are the paramount considerations. If, with these qualities, a little of what is termed class is added, it is like a cake with frosting.

Coach a Bargain for Public

The success of the coach type is due to its actual value as a buy. It is as popular today as when first launched, but it has been necessary to improve its appearance in order to make it a competitive proposition, as practically every car manufacturer lists a model of this type. Its strong points are that it is a substitute for almost every other type of body and its low purchase price, due to large quantity production and the elimination of every part in manufacturing that is not absolutely essential, as, for instance, the use of two doors in place of four and reducing the space for four persons to minimum proportions.

Fig. 2—Modern application of press to production of metal body parts. Fig. 3—Use of belt conveyor facilitates operations in wood shop. Fig. 4—Typical conveyor installation which speeds up work and reduces costs in body trim shop. Fig. 5—Overhead conveyor in paint shop carries bodies through application operations and ovens, saving cost of many men

The popularity of the roadster and the small coupe, sometimes called the roadster-coupe, mark the public sentiment toward small bodies, and these two, with the coach referred to above, practically constitute the bulk of the business of many manufacturers. Having a car to accommodate one's friends does not appeal either to the owner or the friends as it formerly did, therefore the purchase of an automobile is made with a definite idea of the requirements to which it may ordinarily be put, and a two passenger car fulfills the needs of more owners than formerly. In the case of the roadster-coupe the emergency seat in the rear deck can be used for the rare occasions that more than two persons are carried. Illustrations of these three body types are shown herewith.

The axiom of the automobile business has been to pass the profits on to the customer. The body makers in like

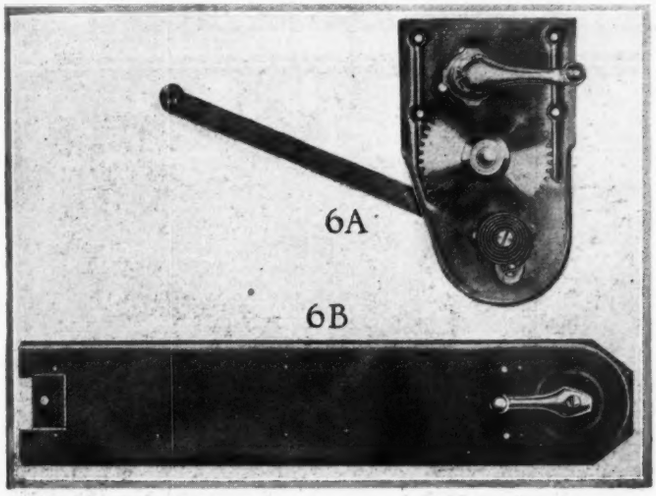


Fig. 6A—Common Sense window regulator. Fig. 6B—Motor Products window regulator

manner have been improving manufacturing methods and making a better body for less money and all through the East where bodies have been made in small quantities on a semi-special design basis, factories have closed up and the proprietors have abandoned the business because they are unable to find a market for bodies made at the old price. In Detroit closed bodies are made for approximately one third the cost of a similar job prior to the war.

The natural query is, How has this been accomplished? Wages are higher. So is lumber, glass and most of the other raw material. Some of the manufactured parts, such as windshields and window regulators, are lower, but on an average there has been a rise both in the material and labor market.

Big Production Lowers Costs

Primarily, the lessening of costs has been accomplished by large production of one type. There are two angles from which this operates toward the end in view, i.e., lowering cost. First let us take the purchasing of supplies. It is apparent to the novice that a better price can be secured on large quantities; then too, a saving that is negligible on a small quantity is a factor multiplied many times in quantity production. For instance, a saving of 10 cents on fifty bodies is $5 but on 5000 bodies it is $500. Next, the preliminary outlay to produce a model. Provided the run will warrant additional investment, more labor saving devices are used and the per capita per body for overhead and layout and fixtures becomes less per body as the quantity is increased.

The economies in production are often measured so that they do not show a balance on the right side until a hundred bodies are produced; that is, until the work becomes automatically operative a certain portion of the first run will be made at a loss.

The track or conveyor is a modern adjunct to the body business. The conveyor is used in varying forms according to the requirements of the system in vogue at each particular plant. Some are operated with an endless chain and in some instances there are automatic lifts taking the bodies at the end of the line to other levels. Then again, there is the track that simply serves as a guide, the bodies being pushed by hand. This arrangement is used for a body mounted on a truck or carriage. At times the track is elevated and the bodies slide without any wheel conveyance.

The purpose of the conveyor is to conserve floor space and regulate the progress and order the direction and passage of the bodies during the different manufacturing operations, and also to permit the speeding up of operations by increasing the number of operations and decreasing the amount of work per operation, thus regulating the rate of output.

Quality Is Not Lowered

In the process of lessening manufacturing costs there has been no tendency to lower quality or eliminate essentials, but various appointments, such as vanity cases, silk curtains, hat racks, robe rails, flower vases and corner lights are restricted to higher priced bodies. Window regulators for operating the glass, however, have become necessary for all closed bodies and the slider channel in which the glass moves is either felt or metal with felt liner to insure silence.

Three types of regulators are shown, the Perfect, the Common Sense and the Motor Products. These are all simple mechanical types which have superseded the chain type and sell for about one third the cost. The illustration of the Ternstedt VV windshield shows another mechanical part which represents reduced cost and improved efficiency, and which makes the cowl ventilator unnecessary.

In connection with locks for the doors of closed bodies provision has been made on even the cheapest cars for a device to prevent opening the doors when the car is parked. Other features that make for lessened cost without impairing value include the use of coach hinges in place of concealed, metal garnish mouldings instead of wood and metal stampings in place of some of the wood framing. This latter counteracts the growing scarcity of lumber

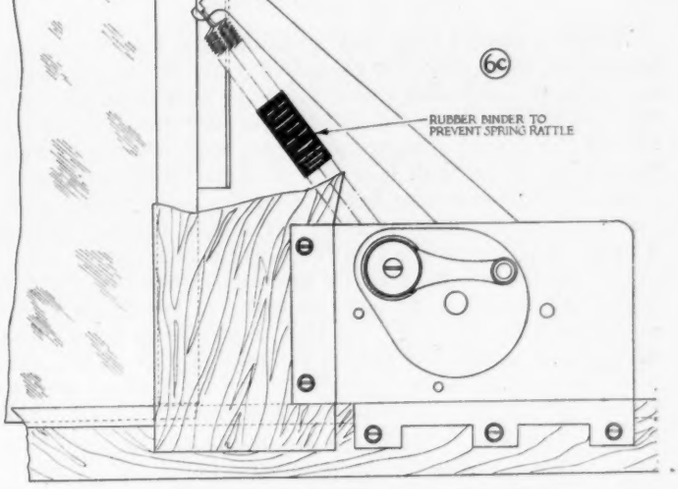


Fig. 6C—Common Sense window regulator

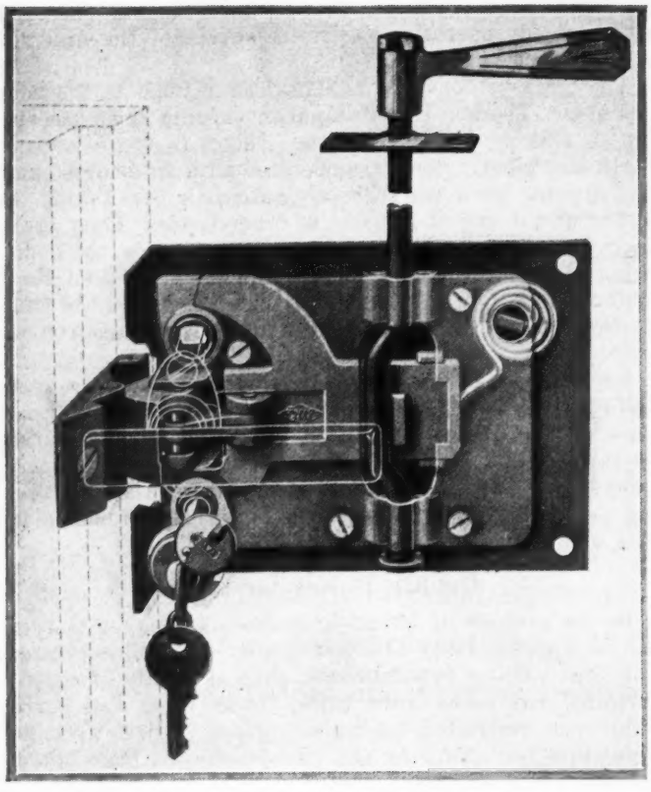


Fig. 7—Ferro rotary bolt-rotary lever lock, an example of modern lock practice

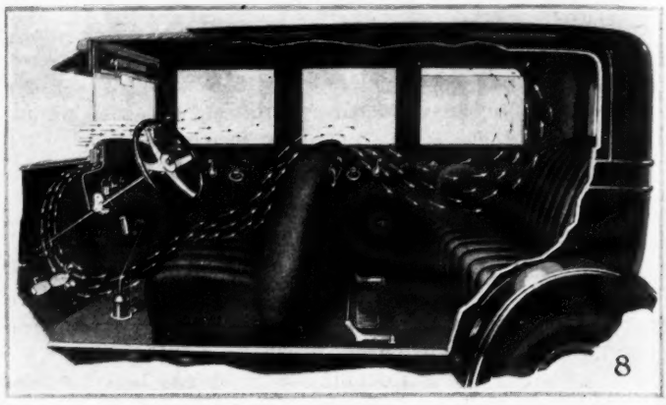


Fig. 8—Ternstedt Ventilating Vision windshield application by which economy of construction and convenience of operation are combined

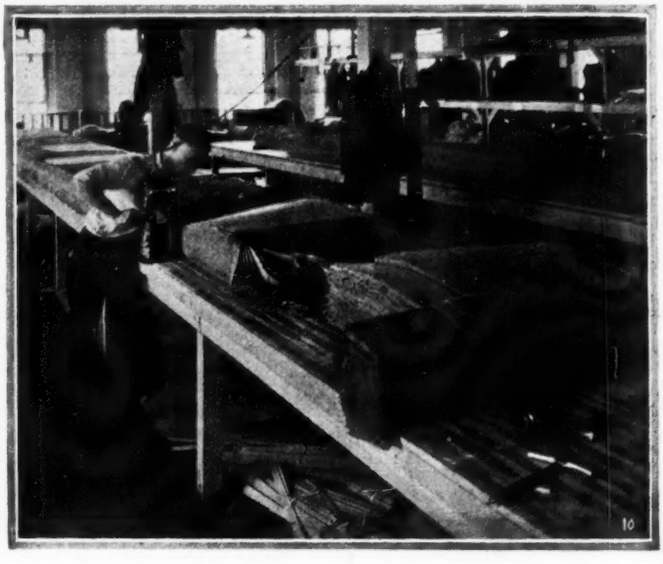


Fig. 9—Modern method of cutting cloth for the interior of the body

and also makes lighter sections of greater strength as well as facilitating the painting operations. A notable example is shown in the Budd door pillar in which the blind spot obstructing the vision of the driver has been reduced by half that on the ordinary body.

The use of steel stampings has been one of the greatest factors in body progress. The illustration shows the product of a large modern toggle, double action press. Stampings come from the press uniform in contour and size and consequently modern body production output has been based on this uniformity of the metal sheets as they are received from the stamping department. In fact, highly important as are the various other factors entering into body development, no single factor is so important as the use of metal stampings, and in proportion as the volume will permit the absorption of the die cost, the final cost of the body can be reduced.

Not All Can Benefit

We must always take into consideration, however, when theorizing, that very few manufacturers are in a position to benefit to the fullest extent from the advantage of quantity production, because, unless the volume is run off to absorb the layout cost, the cost per body will be greater than when made with less expensive preliminary layouts. Any manufacturer who has to feel the pulse of his sales and cater to suggestions from his selling force is not in a position to use to the limit capacity production.

One of the means used by manufacturers who have a variety of models is to have as many of the parts interchangeable as possible. In this way volume production results can be secured for a considerable part of the output. For instance, the same door can be used on several bodies, as can one size of glass. Also the same windshield, etc. In this way not only can the advantage of lower production price be had for these several parts, but in stocking, provided one certain type of body proves a drag or poor seller, it is easy to switch parts from this model to another that is more active, and for replacements fewer parts require to be stocked, as the same parts can be used for several body types.

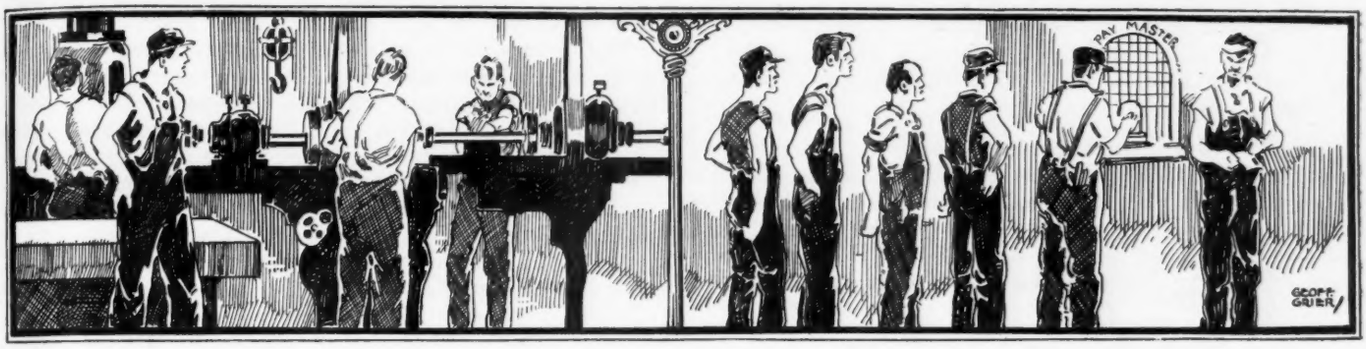
It would have been impossible for body production to reach its present intensive state if the older form of painting were still in practice. Modern systems using a lacquer or pyroxylin base have revolutionized the final finishing of bodies to the extent that weeks are cut to days and days to hours in turning out a finished product. This time saving alone spells a big economy in that not only the body but the complete car becomes a quick asset.

Progress Slow and Orderly

Big strides have been made in body building within the last few years, but it has not been achieved by anything marvelously new in manufacturing, with the exception of the new method of painting. In the other departments it has been a steady accumulation of experience and the application of larger business methods which the standardization and soundness of the business warranted.

REMOVAL of import restrictions over the Franco-Swiss and Italian-Swiss frontiers on automobile chassis, not painted, weighing over 1700 kilos net, and automobiles weighing over 2200 kilos net, and trucks has been accomplished by the Swiss Federal Department of Public Economy.

INCENTIVE VALUE OF WAGE SYSTEMS ANALYZED—



How the Industry Is Approaching the Wage Payment Problem

Prime requisite of any system is that it give satisfaction to the workers. Some form of piece work or bonus plan now used in nearly all plants. Data gathered from 21 companies.

By Norman G. Shidle

A PRIME requisite of a successful wage payment system is that it give satisfaction to the workers. A method of wage payment must have several other characteristics to fulfill completely the requirements of the management; but unless it has the approval of the employees it can't be of maximum value. That is the studied opinion of practically every production man who has given any considerable thought to the subject.

To get maximum results as to quantity and quality at a minimum cost is the object of production management. A wage system to be of real help in achieving that end must embody incentives to the individual worker to do as much work as possible in the shortest period and at the same time maintain a set standard of quality. Wage payment systems should be regarded not merely as a means of getting men to work but as a means of getting them to work as efficiently and as effectively as possible. Necessity will force men to work for wages whatever the basis upon which their individual rewards be determined, but the amount of direct incentive provided in a particular wage payment method and in its administration has a far larger bearing on the unit cost of production than apparently is realized in some automotive establishments.

One big plant a few years back was spending thousands of dollars every year for "welfare work." It was investing huge sums in new tool equipment and in modern systems of handling material. Physically its factories were thoroughly up to date from a manufacturing standpoint. But it was paying its workmen on a straight piece work basis with a definite policy of cutting the rate once the worker reached a specified earning. It was using an incentive system of wage payment and then defintely removing its incentive value in its administration. In other plants similar efforts at physical efficiency have been put forth, while the psychological elements of the wage payment system were neglected. The method of payment sometimes has been determined almost entirely by the management's preference from an accounting or administrative standpoint. While the red-tape and operating elements are important in determining the wage payment best adapted to a particular plant, it is folly to let such considerations obscure the incentive value or lack of incentive value of the method utilized.

Characteristics of a Good System

To be of maximum incentive value a wage payment system should involve insofar as possible all of the following characteristics:

1. The workman should be able to calculate readily how much money is coming to him. The system should be as simple as possible. The average workman should be able to understand it without difficulty.
2. The relation between the reward and the effort should be direct and continuous. As the output increases the reward should increase; at no point in the scale of production should the increase in reward cease—nor should it decline as the rate of output increases.
3. The reward should be directly and visibly dependent on individual effort insofar as possible. Where incentives are on a group basis, the group should be small enough for the individual to feel and see very definitely the effect of his personal efforts on the group achievement.
4. The wage system should take into account the desire of the management for quality as well as

quantity production, for long continuous service on the part of the individual employee and should provide incentives for each of these factors.

5. The wage system must have the entire support of the administrative organization. The officials of the company must be sold on the psychological soundness of the system so that the spirit in which it is administered may be such as to carry out the fundamental ideas embodied in the incentive system itself.

Nearly every manufacturing executive is willing to admit the desirability—theoretically at least—of using a wage payment plan that makes some definite incentive appeal. In a good many cases, however, the value of such an appeal has been considered insufficient to warrant any very exhaustive study of the situation as related to the particular plant.

System Accepted Too Readily

A tendency has existed in some places for the management to accept almost any new system of wage payment that had attached to it the word "incentive," without stopping to consider carefully all of the psychological angles of the case. Some wage systems offer incentives to limit production and decrease efficiency, instead of to increase output and raise the standard of performance.

As Harry Tipper points out, however, in his "Human Factors in Industry," "Of all the systems for general wage payments used at the present time, the ones which are predicated upon the relation between the individual and the quantity and quality of his production are the most effective in their general application."

Considering the relative newness of incentive wage systems, however, the automotive industry has gone a long ways toward utilizing them constructively.

There is little community of opinion as regards the relative merits of some of the better known and more widely used systems, even as regards their application to similar types of work in different plants; but the need for some sort of incentive directly connected with the wage payment is becoming more generally recognized every year. So-called incentive wage systems are more common in the automotive industry today than are the older forms of compensation. A survey of twenty-one representative automotive companies just completed shows the following:

5 companies use a group bonus system
5 companies use individual piece work
4 companies pay on an hourly basis
1 company uses an individual bonus system
2 companies use a group piece work system
1 company uses a differential premium bonus system
2 companies equally divided between group piece work and individual piece work
1 company is equally divided between individual piece work and an hourly basis of payment

Practically all of these companies have some subsidiary method of payment for special types of work which they have not been able to adapt to their incentive plan, although the White Co., which is using the Parkhurst differential bonus plan, has applied it to every man in its factory.

Plants Included in Survey

The survey is based on data from the following companies: White Co.; Chrysler Motor Corp.; H. H. Franklin Mfg. Co.; Autocar Co.; Chandler Motor Car Co.; Packard Motor Car Co.; Hupp Motor Car Co.; Wills Sainte Claire Co.; Nordyke & Marmon Co.; Oakland Motor Car Co.; Stutz Motor Car Co.; James Cunningham Sons & Co.; Peerless Motor Car Co.; Cleveland Twist Drill Co.; Nash Motors Co.; Steam Vehicle Corp. of America; Columbia Axle Co., and General Motors Corp. Data are included from three other important car makers who do not wish their names mentioned. The names in this list are representative of a large part of the automotive field, so that some conclusions as regards the practices of the industry as a whole can properly be drawn from them.

The history of incentive wage payments in the automotive industry goes back only a little over ten years. Before that time the hourly or day rate was practically the only method of wage payment used. The development of incentive systems was a natural result of the demand for quantity production. More units were needed and managers naturally looked about for some means of urging the workers to quicker and more sustained efforts.

Individual piece work, the simplest form of wage incentive, was the first development along this line. Then came various types of individual bonus systems based on a standard time. Not until 1918, apparently, did the idea of grouping workers and placing an incentive for the group come into use in the automobile industry. The first installation of this kind probably was at the Oakland Motor Car Co., where the Wennerlund group bonus plan was introduced in 1918. Since that time the development of incentive system has been very rapid, considerable impetus having been given to the movement in the days of high production demand immediately following the World War.

Innumerable difficulties arose in connection with the first incentive systems because they were put into operation before their objectives and probable effects had been thoroughly considered. Piece work rates, for instance, preceded by several years accurate time study work. Rates were set on a sort of bargaining basis between foreman and worker, with the result that infinite room for intrigue and actual inequalities was present in almost every case.

Cutting Piece Rates Is Folly

The folly of cutting piece rates simply for the purpose of keeping a worker's earnings within what the management considered reason has been pointed out so often that it would seem unnecessary to go over the ground again. To even a superficial observer it would seem obvious that a piece work system has no incentive value whatever if the rates are not guaranteed at least for a specified period—preferably until some change is made in the operation itself. Even today, cutting piece rates is fairly common in the automotive industry, but fortunately for the efficiency of automotive plants the practice is less prevalent than it was a few years ago.

"If you don't cut piece rates, what are you going to do if a man runs away with the job?" That question has been asked. The answer, of course, is that if your time study department does its job properly the man won't run away with the job. If an exceptional man does find it possible to make unusual earnings it is obviously to the advantage of the management to let him go ahead because its profit per unit of production tends to increase rather than decrease as the operator turns out more work.

Certain types of differential premium systems had quite a vogue for a few years in the automotive industry, partly because of the failure of time study departments to handle their work with sufficient accuracy to make straight piece work feasible. The type of differential premium system referred to decreases the worker's return per piece as his output increases, so that gradually the operator works himself to a standstill, reaching a point where added production brings his practically no additional return. Such a condition certainly is psychologically unsound and in the long run probably makes the worker feel that the management is trying to fool him. The natural result is that the system is harmful to efficient production.

To rehearse all the psychological inefficiencies that have cropped up in the operation of wage incentive plans might take an entire volume. It is sufficient to have mentioned one or two of the more obvious and to point out the growing tendency to examine every system from the fundamental standpoint of its effect as a real incentive over a long period of time. How does the worker react to the system? That is the important question which production managers today are asking as regards their wage plans.

The plans in use by automotive companies today stack up fairly well when judged on the basis of incentive value. Some are far from perfection, to be sure, but in certain cases advantages of decreased overhead costs and other factors are believed to outweigh the difficulties involved in the system from an incentive standpoint.

Automotive Plants Use Variety of Wage Systems

Name of Company	Wage System Used Most Extensively	Other Wage Systems Used
Autocar Co.	Hourly rate	Day rate, individual bonus
Chandler Motor Car Co.	Individual piece work Group piece work	Group bonus
Chrysler Corp.	Group bonus	Individual piece work
Cleveland Twist Drill Co.	Individual piece work	Group piece work
Columbia Axle Co.	Individual piece work Group piece work	
Franklin Mfg. Co.	Individual bonus	Individual piece work
General Motors Corp.	Group bonus	Other types
Hupp Motor Corp.	Individual piece work	Day rate
Jas. Cunningham & Sons Co.	Hourly rate	Individual piece work
Nash Motors Co.	Individual piece work	
Nordyke & Marmon Co.	Group piece work	Hourly rate
Oakland Motor Car Co.	Group bonus	
Packard Motor Car Co.	Group bonus	Day rate
Peerless Motor Car Co.	Individual piece work	Day rate
Steam Vehicle Corp.	Hourly rate	weekly rate (for foremen)
Stutz Motor Car Co.	Individual piece work Hourly rate	
White Co.	Differential premium bonus	
Wills Sainte Claire Co.	Group bonus	Hourly rate
AAA. BBB. CCC. — Names withheld by request	Hourly rate Individual piece work Group piece work Individual piece work	Group bonus

Individual piece work is the simplest form of incentive wage payment. The job is studied by a time study man, a rate per piece is set. Every time the worker turns out a piece he knows just how much he has added to his earnings. It would be difficult to find any method of wage payment with greater basic incentive value than straight piece work. A worker with even a minimum of intelligence can understand readily how his wages are figured. So long as rates are maintained and he feels that the company is playing fair with him as regards that fundamental factor, the worker has an entirely visible objective and his earnings are limited only by his own capacity to produce.

Variation in Methods

The only variation in piece work methods from plant to plant lies in the relative efficiency of the time study departments. Upon that efficiency rests very largely the success of any piece work system from an incentive or any other standpoint. Of the twenty automotive companies included in our survey, the five using individual piece work as the chief wage payment system are Nash, Cleveland Twist Drill, Peerless, Hupmobile, and one other large producer. This latter producer uses a group bonus system for workers on assembly lines, trucking and inspection. Nash uses piece work payment exclusively. Peerless pays day rates on some types of work, as does Hupmobile to tool and die workers, plant maintenance men, and common labor. Cleveland Twist Drill Co. uses, in addition to straight piece work, a group piece work system where two or more men work on automatic machines or "where workmen are grouped together in units having a community of interest."

While straight piece work is almost 100 per cent effective from an incentive standpoint because of the very direct relationship between achievement and reward and the ease with which it can be understood, it has the disadvantage from a management standpoint of requiring a relatively large amount of checking and bookkeeping in its operation. The elimination of red tape made possible by use of some other systems has justified the discarding of individual piece work in the minds of some executives, despite the exceptionally high incentive value of the latter method.

Wage systems in which the worker is paid for his efficiency as compared with a standard time are generally designated as bonus systems. In such systems a standard time is set on the basis of time studies. Then the actual time performance of the worker is compared with the standard time and the worker is paid a bonus after having passed some given point of efficiency. Only one company, the H. H. Franklin Mfg. Co., of those sending data for this survey, is using the individual bonus system at the present time. The Franklin wage system is about to be readjusted, however, according to production manager William Dunk, who writes:

> We are at this period preparing to make a general change in our wage payment system. The plan to be used contemplates straight piece work payment on individual machine shop operations, paint and trim shop operations; group bonus on all group machining and assembling work and day work on heat treating, enameling and machine set ups. The major portion of the work, however, will be straight piece work.
>
> We favor the latter system because we believe that piece work is the most direct manner of establishing labor cost and is more readily understood by the average workman. Rates under the new payment plan will be guaranteed for a six months' period unless a definite change is made making it necessary to re-rate an operation.

Administrative expense is relatively as great in connection with the individual bonus system as with straight piece work, the amount of checking and supervision being great because such operations have to be applied to every individual worker.

The direct incentive value of the individual bonus system probably is slightly less than that of straight piece work, because the details of the method of computing the wage are understood less readily by the average worker and consequently the relation between a unit of work performed and the amount of reward is somewhat less obvious.

Time Standards as Basis

The bonus system, however, based as it is on standard time rather than on a price per piece has certain very definite advantages, which may best be discussed in connection

with the group bonus system, inasmuch as this latter type is more generally used in the automotive industry than is the individual bonus system. The advantages apply very largely, however, to both types.

The development of group wage payment systems has come with rapidity recently in the automotive industry because such methods are particularly adaptive to assembly line or repetitive operations such as are common in automotive manufacturing. The group systems, like the individual payment systems, divide themselves into two general divisions—one based on a price per piece and the other on a standard time. But from the standpoint of incentive value certain factors enter into the group plans which are not present when only individual payments are to be considered.

Group Piece Work

We have stated that individual piece work possesses probably the highest incentive value of any method of wage payment. Some of that value is lost when the plan is applied to groups. This statement is almost bound to be disputed. But suppose we examine the evidence.

One typical group piece work system operates as follows: The piece work earnings of the group are arrived at by multiplying the number of accepted finished pieces by the piece price which has been set on the basis of an accurate time study. Each workman in the group has an hourly or base rate. The earnings of the group are prorated on the basis of this hourly rate, those members of the group having a higher hourly rate receiving a higher proportion of the group earnings. The degree of skill required to perform a particular operation within the group is the basis for setting the hourly rate.

In indvidual piece work the relation between individual production and individual pay is direct throughout. In group piece work, where a man's base rate determines his share of the group earnings, raising of one man's base rate automatically decreases the share of every other member of the group. Other members of the group are penalized because of the increased value of a single member. In other words, a man's actual earnings can be decreased without any actual decrease in his personal efficiency.

It may be argued that even though his actual efficiency has not decreased, his relative efficiency has decreased or another member of the group would not have got his base rate increased. Or it may be argued that this whole phase of the group piece work question is academic rather than practical; that the base rates in any given group usually have to be kept fairly equal in any case. With this latter contention we agree. Since the principle is psychologically unsound, the operation has to be handled arbitrarily in an attempt to compensate for deficiencies in the basis.

One advantage of the group piece work system from a management standpoint is that it provides a standard cost per piece which is not affected by the raising or lowering of base rates within the groups.

The group piece work method, properly worked out, still has the direct incentive advantage of individual piece work in being simple to understand. And it has the advantages inherent in any group plan, piece rate or bonus, chief among which are:

1. A group plan makes every worker have a direct interest in the efficiency of every other member of the group. Consequently, members of a group automatically tend to eliminate from the group any unnecessary workers, because the fewer men needed in the group the greater the individual reward of those left.

2. Red tape and checking costs are reduced because counts have to be made only on group results.

The group bonus system simply is the individual bonus plan worked out on a group basis. A standard time is set for the group performance. Then a bonus is paid to the group in proportion to the degree to which it beats that standard time. Earnings within the group are prorated according to the guaranteed hourly rate of each of the men in the group. Practically all group bonus systems work along these general lines, but differences may be found in the relation between the efficiency and wage curves. An individual's base rate may be changed under the group bonus system without affecting the proportionate earnings of the other members of the group.

The group bonus system devised by E. K. Wennerlund, General Motors Corp., may be cited as an example of a typical bonus system that is used extensively in automotive work. The plan as described in presenting it to the workers of a factory in which it is being installed for the first time, is as follows:

Under the Group-Bonus Plan each workman will receive a guaranteed hourly rate regardless of the amount of production secured. The guaranteed rate is the minimum you will receive under any conditions. However, you have an opportunity to considerably increase your earnings above this guaranteed rate.

The feature of this plan is a bonus which will be paid in addition to the guaranteed rate. The bonus is paid when the actual production of your division compares favorably with a standard performance. As a means of securing an accurate and fair measure of the relation between standard and actual production an amount of time will be allowed for doing the work. This time will be set by the Time Study Department and will be known as Standard Time. The Standard Time will be the time required by the average good workman to do the job. The actual time consumed in doing such a job will be compared with the standard time to determine a per cent of efficiency. This efficiency reflects the relation between the actual and standard performance and is the basis on your day rate. The bonus table shows the per cent of bonus which will be paid for each per cent of efficiency.

Methods Explained

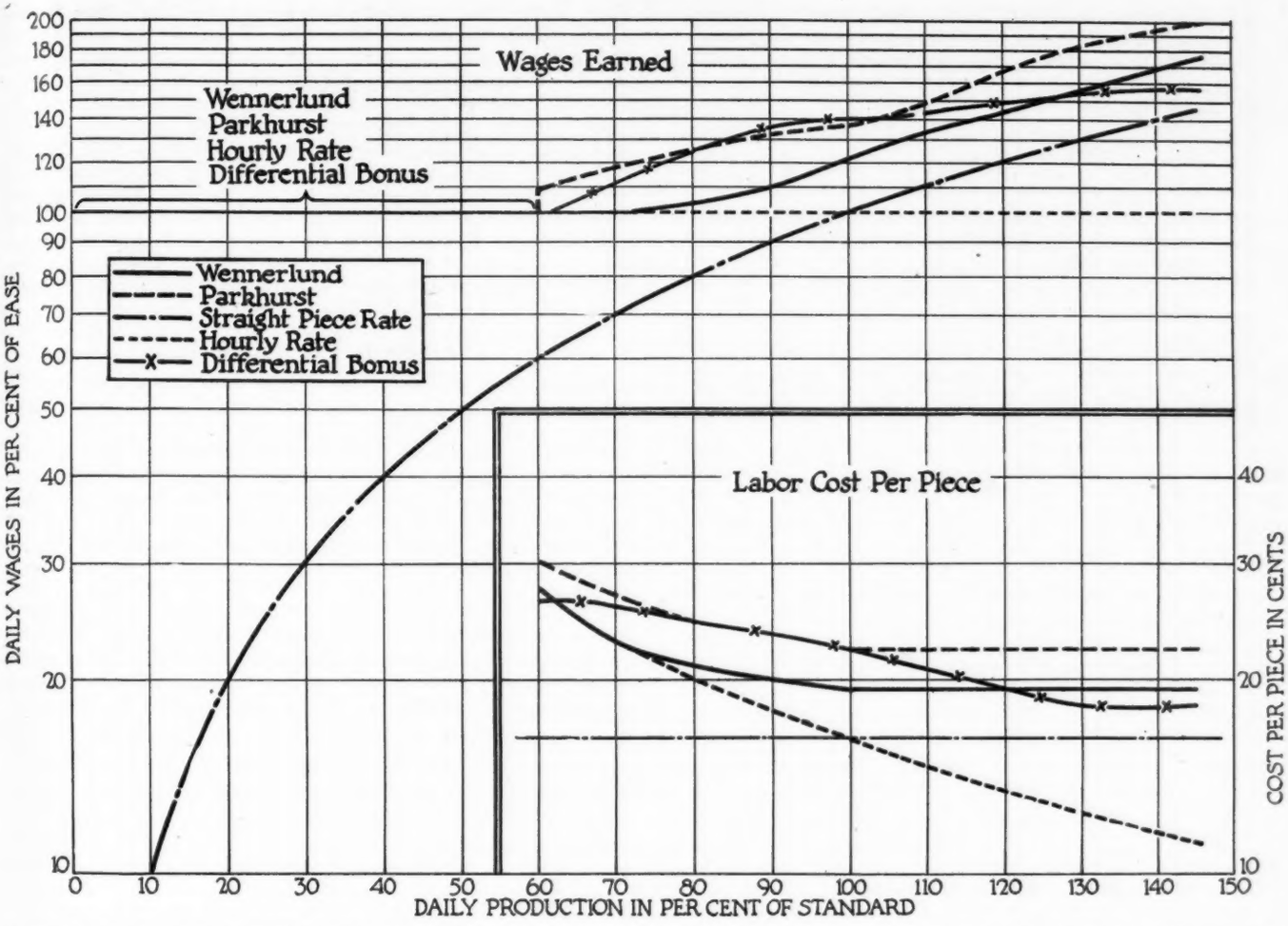
You will note that it is not necessary to equal the standard (100 per cent) in order to obtain bonus. In fact, you will begin to receive bonus when your actual amount of production is 75 per cent of the standard. You will also note that the greater the production the higher becomes the efficiency rating, with a corresponding increase in the percent of bonus.

To facilitate the computation and simplify the details of operation of this plan workmen of each department will be grouped together in small gangs having a community interest. A Standard Time will be set for each group, and for each unit completed by the division the group will be allowed this Standard Time, the total of which will be compared with the actual hours worked by the group. By this method it will be unnecessary for you to lose time in reporting to a time clerk or in changing job tickets when starting or finishing different lots of material.

To clearly show the methods which will be followed in determining the percent of your efficiency, an example is given below.

We will assume a group of five men, which together with two other groups forms a division making a certain part. For each piece finished by the division this group is allowed six minutes, or one-tenth of an hour. The following table presents the necessary data in the most simple form. It shows the hours worked by each man, his guaranteed base rate, and his total direct rate earnings for the week.

Man No.	Base Hourly Wage	No. of Hours Worked During Week	Day-Rate Earning (Rate x Hours)
1	$0.50	50	$25.00
2	.45	41	18.45
3	.45	45	20.25
4	.50	50	25.00
5	.35	50	17.50
Total		236	$106.20



Large chart shows comparative wages earned by workmen under five methods of wage payment when other factors remain constant. Semi-logarithmic paper has been used for this chart to show true relation between rates of change of earnings. Slopes of lines indicate rate of increase so the fact that the Wennerlund and Parkhurst plans terminate in piece rates after task has been reached is evidenced by the earnings curve for these methods becoming parallel to the piece rate curve after standard production is reached. The smaller chart shows variations in labor cost per piece for different working efficiencies under the five plans

During this week 2950 pieces were completed and accepted by the Inspection Department. This quantity multiplied by the standard time per piece gives: 2950 x .10 = 295 hours. This is the number of standard hours allowed the group to do this amount of work. But only 236 man hours were worked by the group. It therefore did more work than specified for standard performance and will be paid accordingly. The efficiency is found by dividing the standard by the actual hours. Dividing 295 by 236 gives 125 per cent, which is the efficiency rating of the group.

By referring to the bonus table on the preceding page you will see that 125 per cent efficiency pays 50 per cent bonus, based on the base wage earned. The base wage of each member of the group is therefore to be increased by 50 per cent bonus. The table above shows this base wage, which we will carry forward to the table below and multiply by 50 per cent to find the amount of bonus. The bonus added to the base earnings gives the amount which will be placed in the pay envelopes.

Man No.	Base Wage	Amount Bonus (Base wage times 50%)	Total Wages Paid	Total Hourly Rate Earned
1.....	$25.00	$12.50	$37.50	$0.75
2.....	18.45	9.23	27.68	.675
3.....	20.25	10.12	30.37	.675
4.....	25.00	12.50	37.50	.75
5.....	17.50	8.75	26.25	.525
	$106.20	$53.10	$159.30	

A study of this example reveals that the percent of bonus can be increased in two ways, either by increasing the amount of production for a certain number of hours worked; or by securing the same production with a smaller number of hours. For example, if the five men had secured 3500 pieces instead of 2950 the efficiency would have been 148 per cent, paying 77.6 per cent; or if the group had secured 2950 pieces without the help of man number five the efficiency would have increased to 158 per cent, paying 89.6 per cent bonus.

Advantages of the Plan

To this explanation is appended the table shown herewith. This table indicates the amount of bonus paid for each given percentage of efficiency.

Writing of this plan, Mr. Wennerlund gives a clear outline of its advantages, many of which are common to every group bonus system. He says in part:

> The bonus plan of payment of wages commends itself for three main reasons:
>
> 1. It offers an inducement to employees to get out a bigger production
> 2. It rewards them in proportion to their rate of production
> 3. It automatically furnishes a means for measure of the efficiency of the workmen, individually or in groups.

Additional advantages of the plan found after it has been put into operation, Mr. Wennerlund lists as follows:

(a) No job tickets are necessary on group operations.
(b) Counting or checking material in lots between operations is eliminated.

(c) Employees need not leave their work or collect coupons to obtain credit for quantities completed.
(d) A spirit of team work is developed in each group, thus materially reducing the labor turnover.
(e) Inefficient workers are eliminated.
(f) Workers may do any operation within a group without transfers or job tickets.
(g) A greater volume of production per man hour is obtained.
(h) With the bonus plan there is no cause for controversy as to the division of earnings among members of a group.
(i) Accurate costs are obtained with a minimum clerical effort.

Obviously a group bonus system is not as easily understood by the worker as is a straight piece work or even a group piece work method. Very careful reading of the foregoing clear explanation of a group bonus system is necessary if one unfamiliar with such matters is to understand thoroughly how the system works. To the extent that it is difficult to understand its incentive value is lowered. Those who are using a group bonus plan successfully, however, believe that its advantages outweigh whatever loss in incentive value may accrue from its complexity.

Bonus Table

Showing Bonus Payment Under General Motors Corp. Bonus Plan

Per Cent Eff.	Per Cent Bonus	Per Cent Eff.	Per Cent Bonus	Per Cent Eff.	Per Cent Bonus
75	1.0	117	40.4	159	90.8
76	1.6	118	41.6	160	92.0
77	2.2	119	42.8	161	93.2
78	2.8	120	44.0	162	94.4
79	3.4	121	45.2	163	95.6
80	4.0	122	46.4	164	96.8
81	4.6	123	47.6	165	98.0
82	5.2	124	48.8	166	99.2
83	5.8	125	50.0	167	100.4
84	6.4	126	51.2	168	101.6
85	7.0	127	52.4	169	102.8
86	7.6	128	53.6	170	104.0
87	8.2	129	54.8	171	105.2
88	8.8	130	56.0	172	106.4
89	9.4	131	57.2	173	107.6
90	10.0	132	58.4	174	108.8
91	11.0	133	59.6	175	110.0
92	12.0	134	60.8	176	111.2
93	13.0	135	62.0	177	112.4
94	14.0	136	63.2	178	113.6
95	15.0	137	64.4	179	114.8
96	16.0	138	65.6	180	116.0
97	17.0	139	66.8	181	117.2
98	18.0	140	68.0	182	118.4
99	19.0	141	69.2	183	119.6
100	20.0	142	70.4	184	120.8
101	21.2	143	71.6	185	122.0
102	22.4	144	72.8	186	123.2
103	23.6	145	74.0	187	124.4
104	24.8	146	75.2	188	125.6
105	26.0	147	76.4	189	126.8
106	27.2	148	77.6	190	128.0
107	28.4	149	78.8	191	129.2
108	29.6	150	80.0	192	130.4
109	30.8	151	81.2	193	131.6
110	32.0	152	82.4	194	132.8
111	33.2	153	83.6	195	134.0
112	34.4	154	84.8	196	135.2
113	35.6	155	86.0	197	136.4
114	36.8	156	87.2	198	137.6
115	38.0	157	88.4	199	138.8
116	39.2	158	89.6	200	140.0

NOTE: An analysis of the above bonus table shows that employees receive the entire benefits of all time saved when the efficiency of production is above 100 per cent.

Variations in the application of the group bonus idea appear in most of the companies using this type of payment. Oakland is using the General Motors' system. Packard has a plan which is described by J. H. Marks, who was responsible for its working out, as follows:

The first step in the application of the system is a detailed analysis of operations to be performed by a given group. From this, time standards are set by accurate time study, which standards do not make any allowances for any losses due to any causes. In other words, the time standards set are the *actual* times necessary for the performance of the operations by a competent workman working under normal conditions without any interruptions such as tool sharpening, obtaining materials, obtaining tools, receiving instructions, and so on. All parts produced by a given group are inspected by inspectors not interested in the bonus. The group is credited each day with the time value of the work produced each day and charged with the total elapsed time shown on the clock cards of members of the group. These same two sets of data are accumulated for a pay period, a ratio is computed and this is called "Group Efficiency."

Standards Are Established

Standards of efficiency are set for each group above which a bonus is paid consisting of 1 per cent for each per cent that the group efficiency exceeds the standard set. These standards are so determined that they allow 20 per cent to 30 per cent, probably averaging about 24 per cent for lost time and bonus. As an illustration, suppose that a group has a standard efficiency of 75 per cent and the efficiency for the pay period is 90 per cent, the group receives a bonus of 15 per cent in addition to their wages computed according to the usual methods.

For non-productive workers we use the day rate system of payment. We do not change standard times once set unless it is apparent that there was a gross error made in doing so, or unless there is a change made in the method, tools, or employment which justifies a change in standard.

Wills Sainte Claire uses a group bonus system supplemented by an hourly wage system for so-called non-productive labor, while Chrysler's Jefferson Avenue plant also uses a group bonus plan more extensively than any other, although its paint and trim divisions are on an individual piece work basis. Chrysler determines its direct labor cost of the group operation as follows:

(a) If only one part is completed by group; divide the total cost of group by the total quantity pieces credited.
(b) If more than one part is completed by group: divide "cost of group" by total standard hours to obtain cost per standard hour. The labor cost of any part within the group is simply the the product of the unit standard time and the cost per standard hour.

Differential Premium System

The single differential premium bonus system reported is that used by the White Co. This particular differential premium system is so worked out as to provide excellent incentive values. It does not involve the psychological deficiencies of the differential premium plans mentioned earlier in this article. The plan is so worked out that the worker begins to get a premium after he has reached an efficiency of 60 per cent of the standard time. This plan connects time wages and piece rates by an arbitrary scale of bonuses. There is a 7 per cent step between the day-wage and the first bonus. This occurs at 60 per cent task. This plan advances bonuses faster than any of the other arbitrary bonus systems and, since it terminates in piece rates, it results in high wages for high productions.

The system is explained by Mr. Parkhurst as follows:

The differential used in the Parkhurst Differential Bonus Plan is a ratio of one to two in output and a ratio of one to ten in the bonus pay differential. In other words, if we take a production range of 50 per cent to 100 per cent, or a ratio of one to two, the equivalent bonus in any one class (job classification) for this range will be in a ratio of one to ten. The simple plan of the whole scheme may be best described by tabulating these two differentials for a simple case. By expressing the production figures in terms of percentage and

showing beside each the equivalent bonus in increments of 10 per cent in the production or percentage column, we have:

Percent of Standard Production	Bonus of Class 4 Pays per Eight-Hour Man Day
50	$0.10
60	.28
70	.46
80	.64
90	.82
100	1.00

Each bonus class number is equivalent, therefore, to 25 cents per eight-hour-man-day bonus pay at 100 per cent efficiency. If a man is working on a job classed 4, he will earn bonus pay in Bonus Class 4—or 25c. × 4 = $1.00. Therefore, this man at 100 per cent efficiency for eight man hours work will have earned $1 bonus in addition to his regular hourly wage rate. If a man worked a full day of eight hours and was 90 per cent efficient, he would earn 82 cents bonus in Bonus Class 4.

This system, the White Co. writes, has been found entirely satisfactory in a test of almost four years.

Complexity a Disadvantage

Despite its advantages, this or any other differential premium system is seriously open to the objection of complexity. The average workman probably never could understand exactly how his earnings are worked out—and to just that extent the incentive value of any differential premium system is lowered. Other general difficulties with the differential premium method of wage payment are outlined with particular clarity in an article written by Louis Ruthenburg, now general manager, Yellow Sleeve Valve Engine Works, in an article published in *Automotive Industries* of Nov. 22, 1923. Mr. Ruthenburg says in part:

"The differential premium system, partly on account of its differential feature and partly because the operator tends to strike a given pace, tends to protect the rate setting department and the supervision when the rates are properly set." (This criticism does not apply to the White system just described, but does apply to all those differential premium systems in which the earnings' curves tend to flatten out once a certain production has been reached.)

"Most differential premium systems," Mr. Ruthenburg continues, "pay the workman on a progressively reduced scale in proportion to the number of pieces produced as his efficiency increases. This is fundamentally unfair. From a practical standpoint, this fact is important because the workman readily sees the unfairness of payments made at a progressively reduced rate per piece as his efficiency increases. The average workman under a differential premium system will soon find the point at which his earnings begin to be badly affected by the diminishing rate of return and will strike a pace just short of that point."

With any of the group systems now so popular in the automotive industry—or with any other wage payment system for that matter—particular attenion has to be given to the method of installation if the system is to operate successfully. The first thing of importance is to establish in the minds of the workers a confidence in the integrity and fairness of the management. One of the most experienced industrial engineers in the industry is authority for the statement that to install properly a group bonus system in a factory of any size is a year's job.

"The first men put on the new system," he says, "must be sold very thoroughly and very carefully on the idea. They must be convinced at once that their earnings are not going to be cut; that they may be increased under the new method. It is desirable to assure them also that members eliminated from their group will be taken care of in other parts of the plant. This usually can be done by letting normal turnover take care of the reductions in force which usually accrue from the installation of a group system.

Should Be Installed Gradually

"The system should be installed gradually. A lot of selling is needed in the first few groups formed. As the work progresses, the necessity for selling the idea decreases, because the system is discussed casually among the workers and by the time the installation has been going on for a few months the method and its results are common knowledge.

"If this original sales work isn't done, however, the news of the plan spreads anyhow, and is likely to embody

NEXT WEEK—

Business Trends and New Models

WIRES have just gone out to *Automotive Industries'* correspondents in all parts of the country which will bring in reply telegraphic reports on automotive conditions throughout the United States. In our issue of Oct. 1, these reports will be summarized to show the actual condition of the retail market as the industry enters the fall season.

Many executives have come to watch carefully these regular monthly business trend summaries in *Automotive Industries* and to check against them the more detailed reports coming from their own district representatives.

In the Oct. 1 issue also will be complete technical data on the new Jordan and the new Marmon models. Brief news announcements of these new cars appear in the news section of this issue.

misinformation based on rumor generated through ignorance."

To work a group plan successfully certain basic requirements must be met. These were expressed particularly well by H. G. Perkins, Chrysler Corp., in a paper read before the Society of Automotive Engineers about a year ago. To make a group plan successful, Mr. Perkins said, these fundamentals must be observed:

1. Individuals can be grouped successfully only when they have a community of interest in the result of their combined efforts.
2. Individual interest in individual accomplishment must be retained, the success of the group being based on individual incentive and ambition.
3. The group must receive *all* the directly increased wages accruing from increased production.
4. The plan used must be sufficiently simple to be understood by the workmen.
5. There must be confidence in the management, induced by a square deal.
6. The supervisory and operating personnel must believe in the group idea.
7. The system should be installed by thoroughly competent specialists who are familiar with the functions of time, cost, inspection, planning and shop departments.
8. There must be a just distribution of group earnings to the individuals of the group.

A wage payment system cannot properly be judged entirely by its incentive value. Yet this phase of wage payments is of primary importance in every case and should never be overshadowed by other factors affecting the choice of a system.

Much remains to be said regarding the best method of wage payment for particular types of work. Further and more detailed researches are needed. Automotive men can profitably exchange more information on this important topic. The present article merely touches on a few of the more fundamental aspects of an immensely complex problem. It may serve, however, to bring into relief some phases of the question of wage payments which most need consideration and to present some data as regards the methods at present in use in representative automotive plants.

Deposits of Molybdenum Ores Listed by U. S.

MOLYBDENUM is the latest of steel-alloying elements to make a bid for popularity in automobile construction. The effects of its addition upon the physical properties of steel have been studied by a number of metallurgists, including Guillet and Arnold, and it is generally understood that it makes a steel more ductile. The alloy first came into extensive use during the war, one of the chief reasons being the scarcity of tungsten, for which molybdenum was substituted. Some trouble is said to have been experienced from irregularity in the product when molybdenum is added in considerable quantity. However, with small additions, and especially when the steel contains other alloying elements besides, these difficulties are non-existant. At any rate, molybdenum steels are being used to some extent in automobile construction and automotive engineers therefore have reason to be interested in a report recently issued by the U. S. Geologic Survey dealing with the occurrence of molybdenum ores.

The aim has been to draw up a systematic list of all localities in which molybdenum ores are found, whether the deposits be large or of lesser consequence. As is frequently the case with the rarer elements, the metal is very widely distributed, but in the majority of instances the quantity of molybdenum present in these scattered deposits is so small as to render extraction on a commercial scale quite impracticable.

When occurring in quantities large enough to be profitably worked, molybdenum is often found side by side with tin, tungsten, bismuth, and copper ores. The two most important molybdenum-bearing minerals are molybdenite, a sulphide of the metal (MoS_2), containing, when in the pure state, 60 per cent of molybdenum, and wulfenite (lead molybdate, $PbMoO_4$), which has a molybdenum content of 26.16 per cent. The former is by far the most widely distributed, and occurs in the greatest quantity in individual deposits.

Ferro-molybdenum, a good sample of which usually contains some 80 per cent of molybdenum, 17 per cent of iron and 3 per cent of carbon, is generally manufactured in the electric furnace direct from molybdenite. Molybdite, a hydrated iron-molybdenum oxide, is often found associated with molybdenite, and is treated along with the latter.

Important deposits of molybdenite occur in the State of Colorado at Climax and Camp Urad, within a hundred miles of Denver; other deposits exist at Questa, New Mexico, and in various localities in Arizona and Alaska. The chief source of wulfenite in America is at Shultz, near Tucson, Ariz. The United States output of ore during 1918, calculated as molybdenum metal, is given as 390 short tons; succeeding years show decreases.

Canada produced over 110 short tons of molybdenum in 1918; the largest deposit in the Dominion occurs at Quyon, in Quebec. South America contributes much smaller quantities, the chief source being Peru, which between 1913 and 1918 produced yearly from 3 tons to 7 tons of molybdenum ore, mainly exported to Europe. Australia produced 114 short tons of molybdenum in 1918, and 107 tons in 1919. The richest deposits are situated in New South Wales and Queensland, and the mines form a chain extending along the whole of the east coast of the island continent. The largest individual deposit is located near Yetholme (N.S.W.), on the slopes of Mount Tennyson.

Molybdenum ores are also produced in southern Norway, at Stavanger and Lister. These mines are the most important in Europe, and came into great prominence during the late war. It has been estimated that the total Norwegian production up till the end of 1920 amounted to approximately 8,800 tons of pure molybdenite. Smaller deposits are also found in Sweden, Germany, Austria, Yugoslavia and Spain. Japan possesses several molybdenum mines, which are being actively worked.

The output of molybdenum ores has fluctuated considerably during recent years, and this is stated to be due, not so much to difficulties in extraction and treatment as to the uncertainty of the demand for the mineral. When it is demonstrated that an open and continuous market for ore, carrying 60 per cent of MoS_2, is assured, it is believed that several thousand tons of the mineral could be produced annually at a reasonable price.

Higher Quality Products Due in Part to Better Cleaning Methods

Automotive plants making use of latest machinery for washing and rinsing of parts to insure clean assemblies. Simple "dip" tanks still utilized largely, though many systems are more elaborate.

FOLLOWING the general trend of automotive manufacturing practice, the methods and means of washing and cleaning parts have advanced far beyond the wiping rag and gasoline bucket stage of earlier days.

With each improvement in equipment, the appreciation of its value in the manufacturing program has been stimulated so that at the present time adequate washing and cleaning facilities are almost as much a part of the production line as are the machine tools.

Where cleaning was a nuisance in the early machine shop and was done only when unavoidable and then by the expedient of a rag, brush or piece of waste and a pail of gasoline or lye water, parts are now passed through regular mechanical equipment where chemical and mechanical energy are utilized to supplant hand labor and its doubtful results. As a result few scaling fenders are seen today and, other things being equal, paint, varnish, enamel and nickelplate stay where they are applied. In the shop, grinder wheels do not gum up, pieces set squarely in jigs and fixtures and parts come out of the heat treatment with some certainty of uniformity.

Fire Hazard Eliminated

The gasoline bucket may be found still in some smaller shops but the whole trend is away from this particular relic of the cross roads shop. With it the fire hazard is great and cannot be overestimated as the vaporous gasoline is spilled on the floor and the bucket is liable to be tipped at any time. Also, cleaning by the process of sloshing parts around in the bucket is a doubtful quantity and the use of rags or brushes helps the cleaning but little and magnifies the fire hazard.

In the trend toward modern equipment, the dipping tank, in which parts are submerged and moved around, appeared. Gasoline was used liberally for this work but in production shops has been replaced by one of the many chemical compounds which now are available for this purpose. No fire risk is involved with these water soluble chemicals and the compound can be selected for its ability to attack any particular oil, grease or cutting compound. It followed naturally that steam coils, or in many cases gas burners, and occasionally electric heater units, were installed with these tanks as the action of the cleaner is accelerated by the heat and agitation produced.

Air and Steam Utilized

In many cases, an air or steam hose and nozzle augment the dipping tank being used to blow off the liquid as the part or assembly is withdrawn from the tank. Occasionally a jet of the same liquid under pressure is used to clean corners, etc. These dipping tanks still occupy an important place in the production scheme as a whole. In this article special cases such as nickel plating departments are not considered and attention is to be focused on general automotive practice as related to the manufacture of machined or fabricated parts like connecting rods, cylinder blocks, frames and small parts.

Fig. 1 shows a steel tank which forms part of the rear axle production line at the H. H. Franklin plant. The steam lines leading to the coils in the bottom of the tank may be seen. It will be noted that this tank is placed at an intermediate point in the line and that further machine operations precede delivery to the assembly line after which the entire unit is cleaned prior to painting.

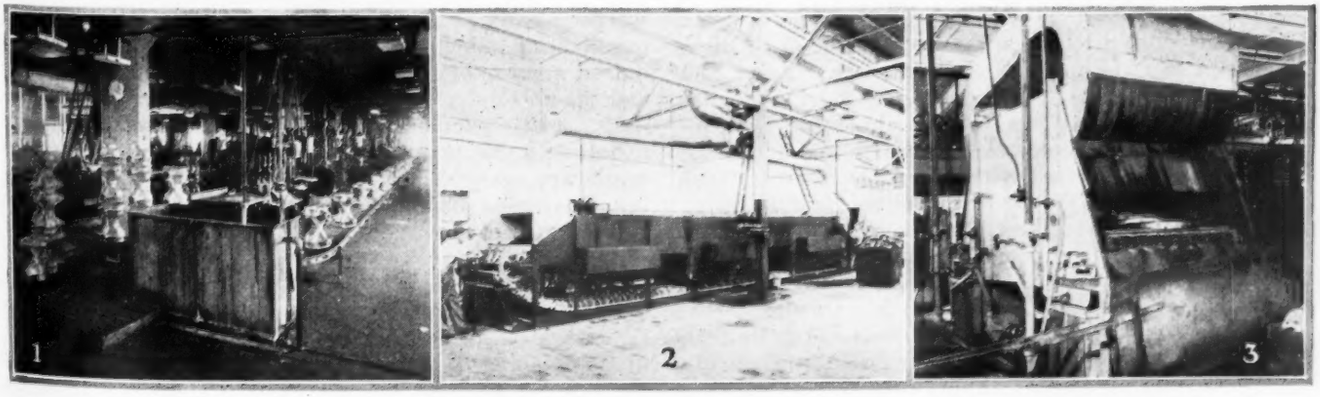


Fig. 1—Installation of cleaning tank midway in the differential housing machine line at the H. H. Franklin plant. Fig. 2—Niagara continuous washer, cleaning, rinsing and drying small steel containers. In process, parts are tumbled to insure thorough cleaning. Fig. 3—Industrial Washer, made by Detroit Sheet Metal Works, fits into felloe band line at Kelsey Wheel Co. Washing compound is used in both stages

With cleaning equipment, as with every angle of the production scheme, the suit must be cut to fit the cloth or the investment in equipment must be adjusted to the demands of production.

For many classes of production, the tank does not fit into the modern continuous line to good advantage. On the other hand, it is an intrinsic part of some specialized installations, such as nickel plating departments, where a succession of tanks filled with cleaning compounds, acids and hot and cold rinsing water are lined up.

As a whole the industry is sold on the idea that clean parts make clean assemblies and finally clean automobiles. Old timers will recall the story of dirt in the crankcase, sometimes core sand and sometimes metal particles that belonged properly in the scrap bin. And not so long ago fenders had a nasty habit of flaking off, or a spot on an enameled body would drop off for no apparent reason. With the elimination of dirt by proper washing and rinsing, these troubles have been eliminated.

Processes Standardized

In the production line of today, every attempt is made to standardize every process so that each piece will come through exactly alike. Moreover, handling is eliminated at every possible point, the objective being the reduction of the much abused human element to the irreducible minimum. In substance, this amounts to the function of the modern industrial washing machine. Each piece travels through at a fixed rate and is subjected for a definite time interval to the washing, rinsing and drying action. As in the case of many automatic and cyclic machines, the operator is charged only with the loading and unloading of the washer and ofttimes even this is eliminated as the machine is installed as an intrinsic part of the continuous conveyor system.

Then the rather indefinite sloshing and drying periods which characterize the human element's operation of the bucket and tank are supplanted not only by the chemical action in combination with heat but by a definite mechanical scrubbing action. The latter is brought about by the pressure pump system which is common to all mechanical washers. A motor driven pump for each solution in the machine develops pressures ranging from 5-7 lb. and upward and the liquid in great volume is forced out of nozzles onto the parts in process. In some designs this action is augmented by rotating nozzles and paddle wheels which drive the jets of liquid violently in all directions.

Application of the modern industrial washing machine can be illustrated best by a number of typical installations representing the washing machines which are built commercially at this time.

Revolving Nozzles Used

Fig. 2 illustrates a Niagara washer, made by G. S. Blakeslee and Co. of Chicago, engaged in washing, rinsing, and drying steel containers. In this case revolving nozzles deliver washing solution, steam and air in turn. The containers are placed in receptacles in the continuous chain at the left and pass through the three successive stages in which nozzles are arranged to deliver jets from all angles. According to the type of work to be washed, this company varies the arrangement of the nozzles and jets, using stationary pipes with drilled holes, stationary adjustable nozzles or power driven revolving drum heads. Also, arrangements can be made to tumble the parts during the cleaning process and thereby introduce the scrubbing action from all angles. Apparently this is the case in the illustration shown, as the cylindrical containers are placed in skeleton hemispherical frames which allow relatively free movement. Several sizes of machine are made ranging from a small unit, in which the work is placed in a wire basket, up to very large specialized machines.

In Fig. 3, felloe bands are shown in process in an industrial washer as built by the Detroit Sheet Metal Works. Framed wire units are carried by the conveying chains, form a continuous table, and in this particular instance commercial cleaning solutions are used in both stages of the machine. Steam pipes leading to the heater coils in the solution tanks are shown at the left. As in the case of practically all washing machines, chips and dirt settle in the bottoms of the tanks and oil is skimmed or drained off the top. In general it has been found that the mechanical cleaning action in the modern washing machine allows a considerable reduction in the concentration of the chemical solution. The washer shown by Fig. 3 fits into the scheme of handling material at the plant of the Kelsey Wheel Co. The outlet end of the machine is shown and the chutes for carrying away the felloes are in the foreground.

An interesting composite installation has been built in an automobile frame plant by this company. A comparison with the former method indicates the advantages of the new installation. Under the old arrangement when the frame had reached the end of the assembly line, it was carried to a wash tank where it remained for several minutes until all accumulated grease and oil was dissolved. From this point the frame was carried to a rinsing tank and then allowed to dry. Then the frame was taken to an enamel dip tank and following the operation remained over a drain board for several minutes and finally was moved to a drying oven. The disadvantages of space, handling and time in this procedure are obvious.

How Frames Are Handled

In the modern installation, the front end of the frame leaving the continuous assembly line comes in contact with a vertical conveyor which transfers it automatically to a horizontal conveyor. This conveyor transports the frame through the three stages of washing, rinsing and drying, the latter being forced, and then continues on through an enamel spray, drying stage and then through an oven. Upon emerging from the oven, the frame passes over a short cooling stage and then is transferred to another vertical conveyor and finally slides down a runway to the loading dock. Practically no element of hand labor is involved in the entire process and uniform treatment is assured.

Fig. 4 illustrates a Colt Autosan metal parts washing machine similar to one in the plant of the Skayef Bearing Co. as made by the Colt's Patent Fire Arms Manufacturing Co. This style of machine utilizes jets below and above the conveyor and, where required, at the sides. These jets are drilled in tubes which can be removed readily for cleaning. Another feature of the machine is a combination pump, that is, the pump units for the required number of liquids are placed in a common housing and the unit drive shaft and impeller arrangement is similar. In this particular instance electric heater units are installed in the tanks but steam or gas heating arrangements are available. Any number of units such as washing, rinsing or drying can be combined in proper sizes to fulfill the requirements of a specific job.

Crescent Cleaning Machine

Large opposed rotating nozzles as shown by Fig. 5 form the active cleaning element in the variety of Crescent Metal-Cleaning Machines built by the Crescent Washing Machine Co. of New Rochelle, N. Y. These machines are built in all sizes which may be adapted to the desired routine. In Fig. 6 is shown a continuous washing and rinsing installation to which an oven drying stage has been attached at the plant of Edmunds and Jones Corp. In one

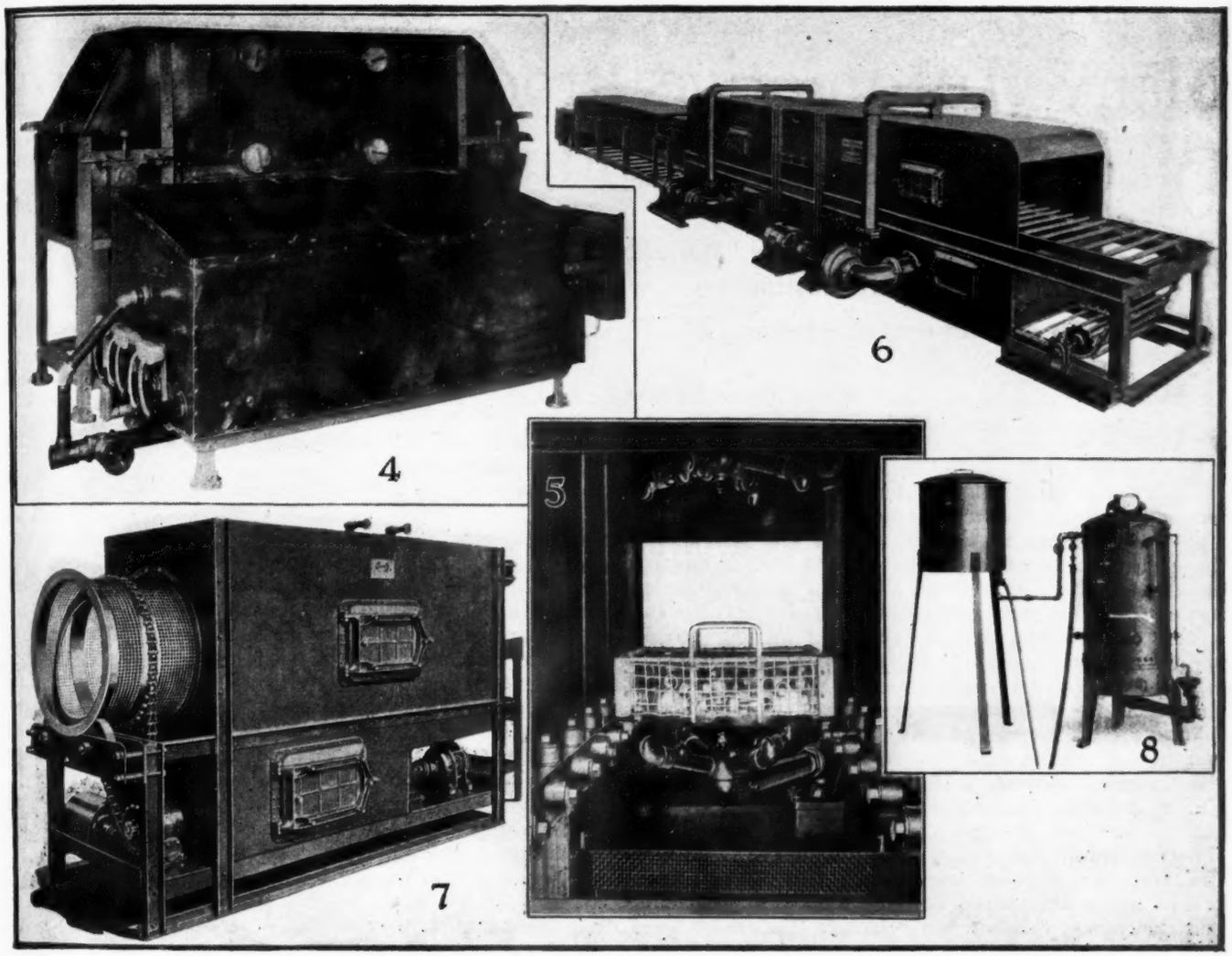


Fig. 4—Colt Autosan washer at the Skayef Bearing Co. plant has electric heating elements in the solution tanks. Fig. 5—Rotary nozzles used in Crescent Metal Cleaning Machine. These are opposed and can be placed at sides to meet demands of work. Fig. 6—Washing and rinsing stages followed by oven drying section. Continuous conveyor runs clear through. Fig. 7—Rotary washing machine for small parts. Fig. 8—McKee Auto Cleaning Outfit in which high pressure steam and cleaning compound are delivered to portable nozzle. Can be used for some types of production work

frame fabricating plant a washing machine of 10½ ft. width is cleaning automobile frames on a routine comparable to that of small parts. In one of the large automobile plants, complete cowls, fenders and hoods in addition to smaller parts such as flywheels, gear case covers and connecting rods are washed, rinsed and dried in machines of similar type. Another plant cleans bar stock for screw machines in the same washer that handles small parts.

Continuous Rotary Machine

A continuous rotary small parts machine made by the same company is shown by Fig. 7. Here a perforated metallic drum which is equipped with an internal helical guide or feed vane is operated by a motor and chain as shown. Parts are dumped into the left end and fed through by the rotation of the drum and finally dumped into a chute or tote boxes at the right end. In the process, the parts such as nuts, bolts, pipefitting or small intricate stampings, forgings and castings are tumbled while being subjected to the upper and lower revolving nozzles and therefore are cleaned from every angle. This machine also is built in stages including the oven drying in accordance with the demands of the work.

Of somewhat different character than the cleaning appliances described previously is the McKee Auto Cleaning Outfit made by the Eclipse Fuel Engineering Co. of Rockford, Ill. This outfit is intended primarily for the removal of oil, grease, tar, etc., and paint stripping preparatory to refinishing. The outfit is used in many refinishing shops and in general work where these materials must be removed and is capable of application to special types of production work. As with continuous washing machines, the composition of the chemical is varied to meet the material to be removed and this chemical action is combined with the mechanical effect of a jet.

Gas-Fired Steam Boiler

As shown by Fig. 8, a 4 hp. gas-fired steam boiler supplies high pressure steam to the cleaning nozzle and to coils in the solution tank, thus supplying the elements of heat and pressure. The desired solution is carried in the tank shown at the left and both this unit and the boiler are connected by hose to the spray nozzle, which resembles somewhat an oxy-acetylene torch. The solution tank has a capacity of 22 gal. and the boiler delivers 60-70 lb. pressure. The spray nozzle is 4½ in. long and feeds the solution by a combination of gravity and injector action. The length and contour of the nozzle permit access to remote corners and cavities.

Many Automotive Production Problems Solved by Welding Processes

Outstanding applications in manufacture of chassis are in salvaging defective cylinder and crankcase castings and in welding up rear axle housing. All forms used in body construction.

By P. M. Heldt

THE various systems of what may be designated as machine-welding (to distinguish it from the blacksmith's hand welding) have come to play a very important role in the manufacture of motor vehicles.

Of the two systems now in general use, gas welding (also known as acetylene welding) and electric welding, the latter was originated first, a number of experimenters having worked with it during the early eighties, but it is a fact, nevertheless, that the acetylene welding process, which originated in France in 1900, was the first to find extensive application in the automobile industry. One of the reasons for this may have been that during the decade following the invention of this process automobile development was carried on in France very intensively, and as the acetylene welding process was being pushed there, French automobile manufacturers naturally looked to it for the solution of some of their production problems. However, before being adopted as a manufacturing process, acetylene welding was widely used for repairing broken automobile parts, such as aluminum crankcases and gear cases, cylinder water jackets cracked by frost, etc.

The first of the electric welding processes to come into extensive use was the butt-welding process, which was developed by Prof. Elihu Thomson, and the writer remembers seeing this system applied in 1898 in the welding together of the spokes and hubs of agricultural wheels. Later the two systems of arc welding, by the carbon arc and the metallic arc, respectively, were developed to a practical stage, and finally came the spot welding process which is now so widely used in the fabrication of sheet metal parts. Flash welding is merely a variation of the butt welding process.

With so many different processes available it is quite a problem to determine which of them is best adapted for any particular job. Of course, to use welding to the best advantage in manufacturing operations, the parts must be designed in the first place with that object in view. Education of designers with regard to the possibilities and limitations of the various processes is therefore of the highest importance. A helpful factor in this connection is that the various manufacturers of welding machines and equipment are represented in the centers of the automotive industry by men who combine familiarity with automotive manufacturing problems with a thorough knowledge of welding processes and who are willing to place their knowledge and experience at the disposal of car and parts makers in the solution of their production problems.

Used for Reclamation

Welding is at present widely used for the reclamation of imperfect castings, forgings and pressings. This is an application of the process of which those who are using it do not seem to be particularly proud, and it is therefore somewhat difficult to get precise information on it. Just why this should be so is hard to see, for with such intricate castings as cylinder blocks, for instance, there will always be a certain percentage of "rejects," and if these can be salvaged by a comparatively simple and inexpensive process it would seem to be perfectly good engineering.

The imperfections in cylinder castings generally show

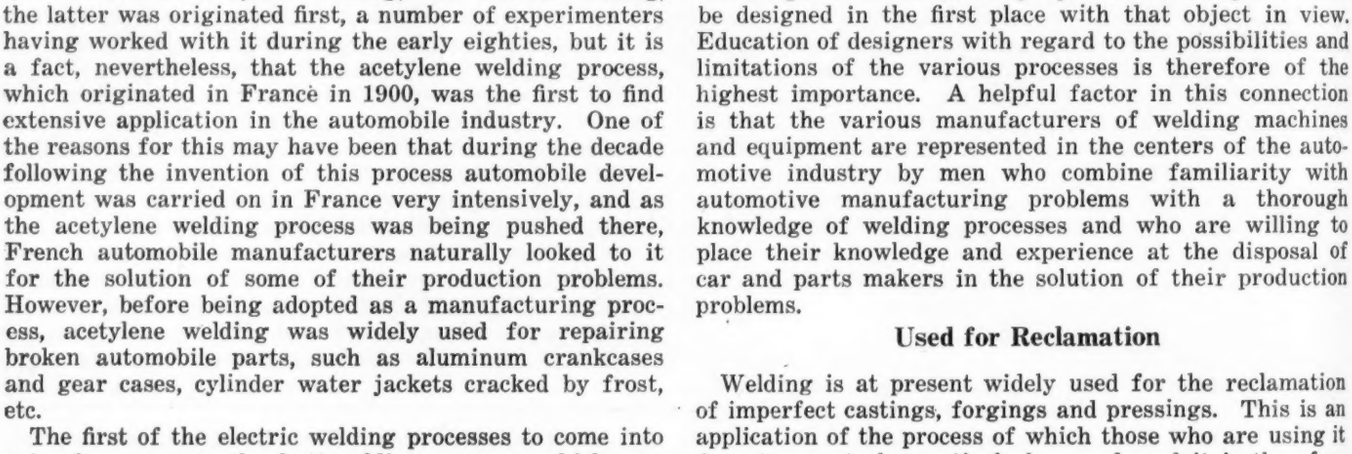


Fig. 1—Examples of welded automobile parts. 1—Lamp bracket; 2—Clutch throwout shaft with lever welded on; 3—Welded windshield frame; 4—Water manifold; 5—Ignition contact screw; 6—Spark control lever; 7—Poppet valve

up during the general inspection or during the water test, which latter is made before any machine work is done on the casting. Porous spots are particularly troublesome, but there are many other possible defects which would make it necessary to reject the casting if no reclamation process were available, including shrinkage cracks, cold shuts, blow holes and deficiency of metal on surfaces to be finished. Oxy-acetylene welding is used for salvaging these castings, as well as a process known as semi-arc welding.

The latter process, developed by the Allan Mfg. and Welding Co., Buffalo, N. Y., permits of welding light cast iron sections without the necessity of pre-heating the block. By this method one globule of the welding metal is deposited after another, and it therefore differs from the continuous arc welding process. By depositing one globule after another the heating of sections of the casting is minimized and cross checks across the deposited bead are thus eliminated, it is claimed.

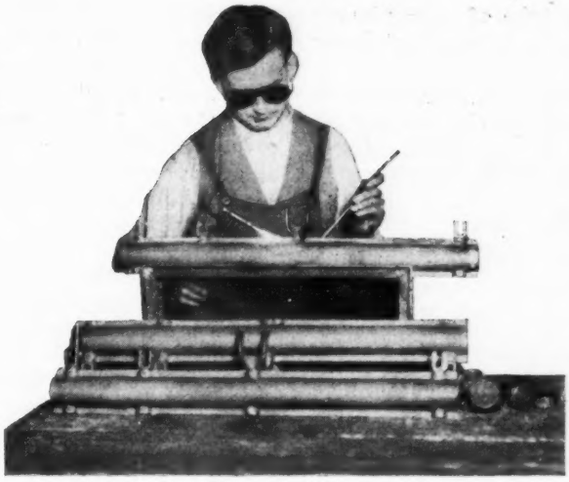


Fig. 2—Gas welding hollow pedal shafts made of two stamped sections

Semi-Arc Salvaging Process

For the filler metal a nickel alloy is used. With this method a higher voltage and amperage are employed than with the regular arc process, which permits of the proper fusion of each globule irrespective of where the globule may be deposited. This method of salvaging is in use by two Cleveland foundries specializing on cylinder castings.

Much of the steel tubing used in automotive construction is welded by the oxy-acetylene torch. The material is originally in the form of flat strip, which is rolled into tube form, and the joint is then welded. The process is an automatic one. A stationary water-cooled torch with multiple jets is used, the number and size of jets being determined by the thickness of the metal in hand. The first of the jets preheats the metal and the last one brings it up to welding heat. The seam is formed by merely compressing the tube, no welding rod being used.

The subject of welding in automotive production is a very broad one and cannot be exhaustively dealt with in a single article. Probably the best plan to follow is to take up one part of the chassis after another and then pass on to the body and the accessories, mentioning instances where welding is employed in the fabrication of the parts and giving some details of the processes.

Welding plays a very important part in the manufacture of certain types of aircraft engine, of which the Liberty is a good example. The cylinders of these engines are really built up from forgings and pressings by means of the welding process. In the ordinary automobile engine all the more complicated parts are made of castings, and there is therefore less scope for welding applications. Still many of the smaller parts are welded up of several pieces. Reclamation of defective cylinder castings, crankcase castings and crankshaft forgings has been referred to already and need be mentioned here only in passing. Valves are now often made of different metals for the head and the stem, and these parts are then welded together. In the smaller engines cast iron heads are used to a certain extent, and these are welded to steel stems. This operation can be performed with an electric spot welder, for instance. In other cases heads of alloy steel are welded to stems of carbon steel and in the case of the valves of the Wills-Ste. Claire engine the valves are composed of three parts of different materials, all welded together.

Cast iron valve heads are usually drilled out to receive a reduced portion of the valve stem fitting it tightly, and the joint is welded only at the top where the stem projects from the drill hole, whereas valves composed of different grades of steel are generally butt-welded.

By the ordinary process of welding cast iron valve heads to steel stems something like a rivet joint is formed, the end of the stem protruding through the hole in the head being welded over, as it were. A method of butt-welding cast iron heads to steel stems at a high rate has been developed by P. M. Hall of the Taylor-Hall Welding Corp. of Worcester, Mass. By this process the end of the stem where it is welded to the head is first upset, and at the weld the diameter is considerably greater than the regular diameter of the stem. In a Model 30 SF Thomson butt welder with air clamps and hydraulic cylinder, as many as 400 valves can be welded per hour. The cross-sectional area of the joint is made equal to three times the area of the stem, and in a tension test failure occurs in the stem and not at the weld.

Welding can also be applied in the manufacture of mushroom type cam followers or even of long tappet rods with yokes for rollers at their ends.

The simple form of inlet manifold without hot-spot is now used on only few engines, but this lends itself very well to manufacture by the welding process. Sometimes a water return manifold is used on top of the engine, and this can be made in the same way. Tubular cross members for the frame have come into extensive use in recent years. The end flanges, by which the tubes cannect to the frame side members, are often welded on. In one case the tube connects to the rear end spring brackets which are piloted into it, the tube being welded to the pilot bosses.

Bronze Welding

The oxy-acetylene torch is used with a process known as bronze-welding, which is very similar in its effects to brazing. It is used particularly for joining castings or castings and forgings, and gives a very secure joint, as may be judged from the fact that it is employed for welding the supporting arms to the Ford engine. In this connection it may be pointed out that the oxy-acetylene torch is also used for soldering. It might appear at first sight that the flame would be much too hot and would burn the solder, but the method used consists in heating the surface of the parts to be soldered by means of the torch and then melting the solder by contact with these surfaces. Bronze welding is also used in the manufacture of door hinges for certain bodies. The hinge plates are punched out and have the eyes formed by bending the flaps into the proper shape. The eyes are then closed by the oxy-acetylene torch with a bronze rod for welding material.

In the manufacture of mufflers, machine welding has an important place. Mufflers are now generally made entirely of sheet metal and tubular parts, and these parts can be assembled to best advantage by welding. The muffler used on the Star car, which also forms a frame-

stiffening member and has an outer tube of rather heavy gage, is torch-welded along the side seam and electrically welded at the ends.

In one muffler the outer cylindrical shell, the trumpet-shaped end pieces and the perforated partitions are all flanged; the parts are assembled with these three flanges side by side and the flanges are then welded together.

Metal Cutting Applications

The acetylene torch is used also for metal cutting, and a number of cutting applications are met with in the automotive industry. In steel foundries, which are one of the sources of supply, particularly of the truck industry, the acetylene torch is used for cutting off risers and gates from steel castings. The McCord Radiator Co. cuts a hole in radiator shells by means of the torch, and the process is commonly used in roughing out male die blocks.

Pressed steel oil pans afford some opportunity for the use of the welding processes in their manufacture. The bosses for the drain plugs, for instance, can be fastened in place by welding, as well as reinforcing plates on the flanges and at other points.

The same as cylinder block castings, defective aluminum crankcase and gearcase castings may be salvaged by means of the welding process. The welding torch and the electric arc are also made use of in the drop forge to salvage defective forgings, particularly the larger forgings such as those of front axles and crankshafts. In making pressings of sheet metal the metal is sometimes overstrained at the bends and cracks, and these cracks can be filled up with the torch or the arc and suitable welding rod.

That welding will be used much more in the industry in the future than it is now is indicated by the fact that whenever changes are made in the design of the car, particularly in connection with the parts on the outside of the body, welding is usually employed for some of the operations. An example of this is seen in the radiator shutter which is used on the Cadillac car for the first time this year. The hinge pins of the shutter blade are spot-welded to a flap and this flap in turn is spot-welded to the blade itself. As designing engineers and production men become more familiar with the different welding processes and their possibilities, they will find constantly new operations which can be done better by welding than by any other known method.

Butt welding is largely used for joining rod ends such as eyes and yokes to brake rods, steering tie rods, etc. Sometimes levers are welded to the ends of shafts, as in the case of the clutch lever and the Chevrolet spark lever.

Welding equipment is sometimes used for other than welding purposes, for merely heating parts so they can be readily re-formed in dies or otherwise. In the assembling of a certain muffler there is required a collar on a central pipe to act as a stop. In order to form this collar (or bulge) the pipe is gripped in two semi-cylindrical copper dies of the welding machine, and the current is turned on. Within a very short time the section of the pipe between the dies becomes red hot, and the dies are then pressed toward each other, throwing up a bulge in the wall of the pipe. These pipes, which are 1½ in. in diameter and of No. 19 gage, are handled at the rate of five a minute.

Another example is the gear shift lever of the Cadillac car. This lever, which is of the ball-mounted type, is first machined straight and is then heated in an electi welding machine immediately above the ball, to bend it i a die to the form somewhat characteristic of this lever.

There does not appear much opportunity for welding on the transmission, except possibly in connection with the cover plate and some other parts of the housing. The Cadillac Motor Co. this year has changed over to a pressed steel bottom plate for the gear housing, and a flanged boss to take the drain plug is spot-welded to this plate (Fig. 3). The flange lies on the inside of the plate, in a depression, and is spot-welded to the plate at three points, and as the drain plug has a shoulder the tendency is to draw the flange against the plate independent of the weld.

A good many cars use a spherical housing for the universal joint at the forward end of the propeller shaft, which is supported in a spherical socket at the rear end of the transmission. The Chevrolet Motor Co. now forms this spherical housing from two sheet metal pressings by butt-welding them, the process employed being similar to that used for welding the rear axle housing. To weld this ball requires 1200 amperes at 7 volts for about two seconds.

Pressed Steel Housing

It was the introduction of the welding process that made the pressed steel rear axle housing a possibility. The first pressed steel housings were welded by the acetylene torch, but at present the welding is generally done by the electrical process. At the present time arc welding is employed in the majority of instances but butt welding is coming into use.

A good example of an arc-welded or a seam-welded rear axle housing is the Cadillac, of which a drawing is shown herewith (Fig. 4). The axle housing is built up of two main pressings, two axle tubes and two semi-cylindrical re-inforcements which form the differential housing. The parts are assembled in a jig and are first "tacked" together by welding at eight points, four points on each side of the center. Next the joints between the main pressings, the edges of which are beveled off and spaced 3/16-¼ in. apart, are seam-welded the entire length. The axle tubes are also seam-welded to the re-inforcements all around and the re-inforcements are "tacked" to the main pressings at eight points. The seam welding is done with a U. S. L. welding machine and the tacking with a Short Arc welding machine.

In order to secure a firm joint between the axle housing and its sleeve at the outer end, the pressings of the housing have oblong holes punched through them during the pressing operation. At this point the sleeve fits the housing snugly and the two are welded together by filling up the holes with welding rod. The welded connections between the housing and sleeve are located where the spring saddle and brake support come, and this portion of the axle housing is turned down after welding and then

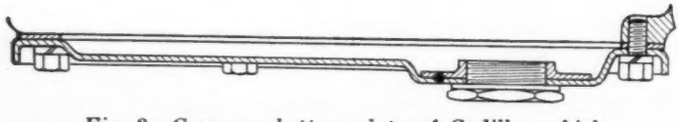


Fig. 3—Gearcase bottom plate of Cadillac which has drain plug flange spot-welded

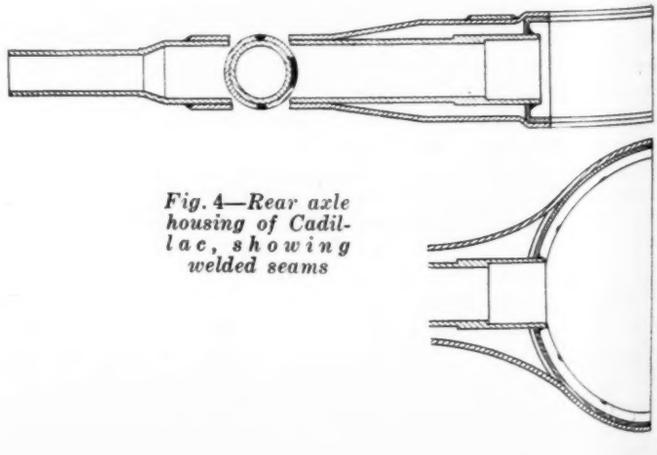


Fig. 4—Rear axle housing of Cadillac, showing welded seams

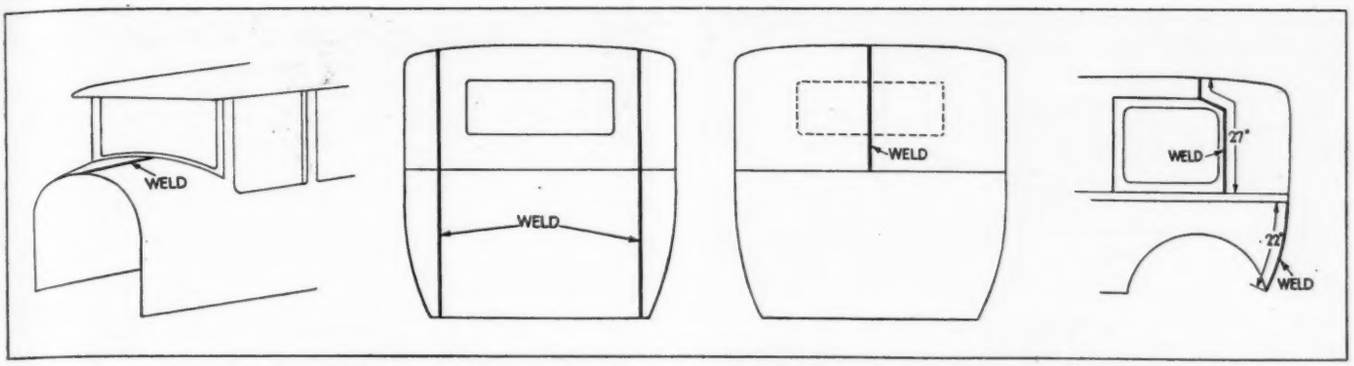


Fig. 6—Diagrams showing how body panels and cowls are formed by welding

ground. In addition, pads are welded to the forward side of the axle housing for the brake shaft brackets to fasten to. The welding operation distorts the axle housing and after the welding is completed it is straightened in a machine.

One man assembles in a jig and "tacks" forty axle housings a day, and one man seam-welds 13 axle housings per day.

Butt Welding Axle Housings

A rather recent development is the butt-welding of rear axle housings, and two machines for this purpose are now in operation at the axle plant of the Chevrolet Motor Co. in Detroit. These machines are installed in a direct line with the presses by which the axle housing stampings are blanked out and formed. Welding is effected by what is known as the Murray welding process, developed by the Metropolitan Engineering Co. of Brooklyn, N. Y.

Copper dies are provided which exactly fit the outside of the housing stampings. One die is stationary and the other movable, and in order to carry the current to the movable die there are provided on the machine a series of large knife switches which are opened and closed by the motion of the movable die. The dies are forced together by means of eight electro magnets, four on each side of them. For effecting the weld a current of 6,000 amperes is allowed to flow for five seconds, the voltage required being seven.

The two welders are arranged in parallel, and welding in them takes place alternately. The reasons for this are that the time required for the welding operation, including the loading and unloading of the welder, is about twice as great as that required for making the pressings, and that if the two welders are operated alternately and never at the same time, the same generator can be used to supply the two welders alternately and the fluctuations of the line current will not be as great as if the two welding periods over-lapped.

Current for the welding operations is furnished by the Detroit Edison Co., three-phase current at 4600 volts. A three-phase motor of 1200 hp. is directly connected to a 1000 kw. single-phase alternating current generator delivering current at 375 volts. The voltage is stepped down to that required for welding by transformers built into the welding machines themselves.

Electric welding (butt welding) is used in making the rims of automobile wheels, and as comparatively little is known of the process of manufacturing these rims outside the specialized industry devoted to this component, it may be outlined here.

The stock comes from the mill in the form of flat strips and the first operation consists in shearing off to the proper length. Next these lengths are "coiled" or rolled to the circular form in a coiling machine, and this is followed by the process of butt welding. This, of course, leaves a burr, and the removal of the burr is the next operation. The cross section being still straight, the burr is removed by a planing operation, with as much ease as a carpenter removes a shaving from a piece of wood. In some cases a workman goes over the weld with an emery wheel to clean it up.

Next the ring of flat steel goes down the line and is then passed through rolls which give it the desired cross section as required for a rim or steel felloe. Next the rim or felloe is sized. Generally it is welded up very slightly below size, and is then expanded accurately to size by means of a taper ram which is forced through it to stretch it. Some manufacturers, however, follow the reverse procedure and weld the rim slightly oversize, then reducing it by a compression operation. While as here described the sizing follows the forming operation, it sometimes precedes it. Next the various holes in the rim or felloe are spaced and punched, the rim is inspected and it is then passed down the line to the stock rooms or is loaded into cars. In the production of collapsible rims, strange as it may seem, the rings are first welded up and then, in the last or final operation, they are split or cut apart again. In rim production one man welds as many as 400 rims per hour.

Windshield Frames

Windshield frames are generally welded electrically and at the present time the preferred method seems to be by the use of the flash welding process. These rims are made of special section drawn stock, generally tubing with a groove formed in it at one side to take the glass. Originally the pieces forming the individual sides of the frame were mitered and welded together in a butt-welding machine. With the flash welding process the channel is cut off square, adjacent ends of parts to be welded together are clamped in the dies of the welding machine and these dies are then automatically moved toward each other. As soon as the corners of the square-cut ends come together an arc is struck, which burns or oxidizes the material, sparks being thrown in all directions. When enough material has been thus burned away to form a perfect mitre, the current is automatically shut off, the burning action ceases, the temperature drops slightly and the parts are then pressed together by a quick motion of the hand lever. This forces the burnt metal out of the joint and effects a sound weld.

There are also a number of auxiliary welding operations on windshield frames, varying with the different designs. In some cases a handle for opening or closing the windshield is spot-welded to the frame, and the hinge around which the upper frame swings may be secured to the frame by the same process.

Body panels are generally pressed from steel sheet of a special grade. In the past aluminum sheet has been used to quite an extent for closed bodies, as the impres-

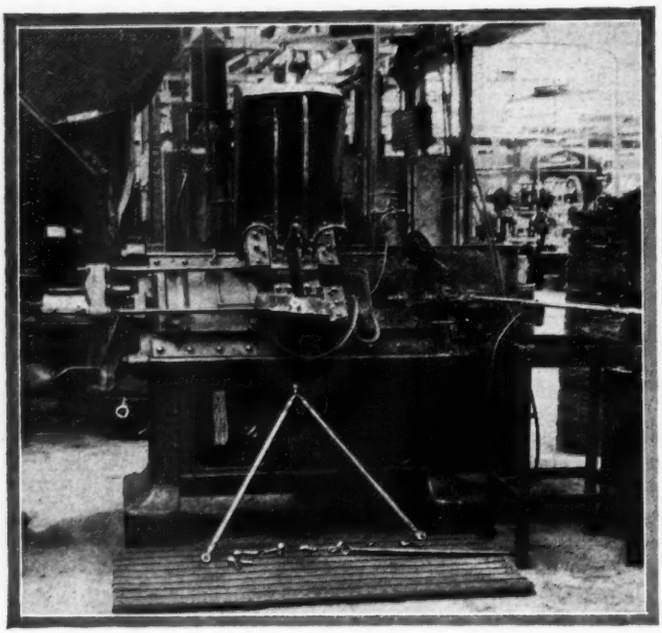


Fig. 5—Welding Ford radius rods in Winfield 45-deg. machine

sion prevailed that with this metal, which has the reputation of being non-sonorous, there would be less "drumming." However, recent investigations are said to have shown that there is no appreciable difference in the drumming with the two metals, and as a result aluminum sheet seems to be losing ground even in high class bodies.

A cheap method of body construction consists in tacking the formed panels to the wooden frame and then soldering over the edges of the panels and the heads of the tacks. Any surplus solder can be readily removed and a smooth joint obtained. It is obvious, however, that a body so built cannot be claimed to possess a high degree of strength, and for this reason the bodies of the majority of car models now have their panels welded together.

Other Processes Used

Aside from gas-welding, both seam-welding and butt-welding are employed, the latter process having come into use most recently. The use of welding in body construction is to a considerable extent dependent upon the fact that it permits of more economical use of the body sheets. If it were attempted to stamp the whole of the rear panel in a single piece, there would be great waste of material, and for this reason it is customary to form this part in three pieces which are welded together. Sometimes small pieces are even welded to the sheet before the panels are stamped out, as this permits of more economical utilization of the sheet and also eliminates the necessity of rolling special size sheets for which the mill makes an extra charge.

With aluminum body panels acetylene welding is commonly used, as with that material it seems to give better results than the electric arc. The panels are often formed by hand-beating over suitable forms.

Parts Held in Jigs

In seam-welding of body panels the panels are held in jigs provided with clamps forming a V groove where the seam is to come. The welder thus works at the bottom of this V groove. In the welding of the upper back panel or of the rear seat panel, both of which require two welds, one at each corner, two men usually weld simultaneously on the same panel, each making one weld. These seam

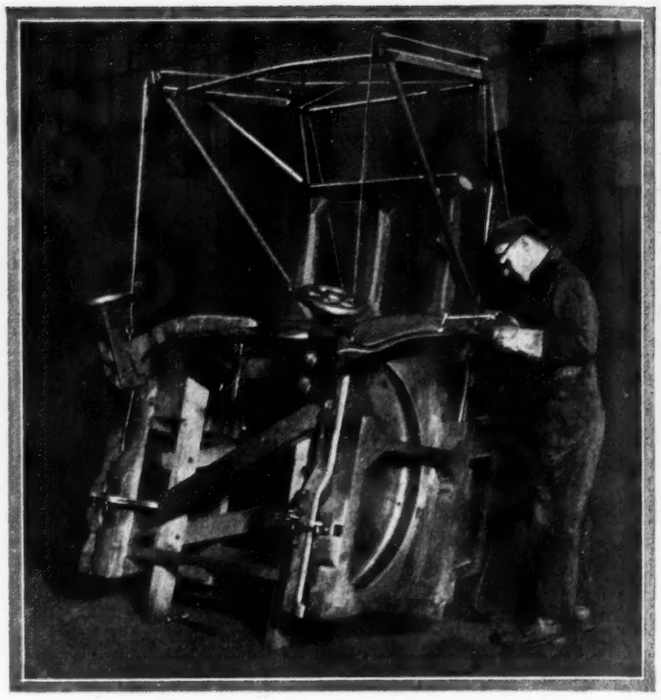


Fig. 7—Gas-welding quarter-back panel to back panel in a jig. There are two seams, 25 in. long each, and the welding operation, including jigging and unjigging, takes 10 minutes in piece work

welds are made either by the oxy-acetylene torch or the electric arc.

Recently butt-welding has come into use for welding body panels, and with this method the rate of production is greatly increased. Some data on butt welding of body panels, rates of production, etc., were furnished the writer by A. E. Hackett, Detroit manager of The Federal Machine and Welder Co., Warren, Ohio, which firm has furnished welders for this purpose to several automobile plants.

The upper back panel of a closed body is usually made in three pieces. In one particular case, where the panel is made of No. 19 gage steel, there are two welds, each 27 in. long. These panels are welded at the rate of thirty per hour, and very little grinding is said to be necessary. The welding is done in a combination jig.

Finishing Body Joints

The finishing of the joint on body panels is a subject in itself. Necessarily the joint must be finished off very smooth, so that after the body has been finished it will not show. One very quick method consists in placing the panel, after it has been welded, over a cast iron block of corresponding form, which has groves underneath the seams of the panel. The seam is then hammered down so that the extra metal enters the groove, and the irregularities on the outside are filled up with solder which is finished off smooth. Of course, wherever solder is used to smoothen the joint it is impossible to use the high temperature drying or baking process.

The corner seams of a rear seat panel, which are 22 in. long, are welded in about the same time. In this case two welders are used, one for the seam on each side.

In one case the back panel of a closed car is welded in a double Federal machine. The center section is held in the stationary die and the outer sections are held in movable dies. The weld is 48 in. long, and the two welds can be made either simultaneously or separately.

In the manufacture of all-metal bodies, which are used

Fig. 8—Welding corner pieces into the flanges at the opening for the rear window in a closed body

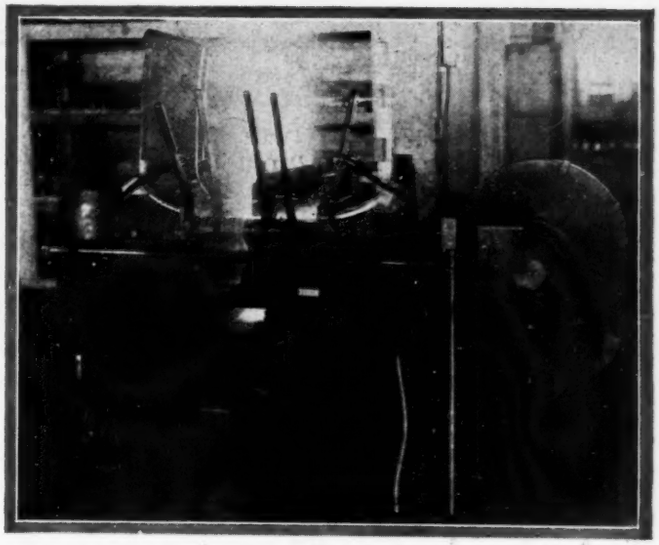


Fig. 9—Flash-welding of cowl on Winfield sheet metal welder

on some of the popular priced cars, somewhat different methods are followed than in the construction of the wood-frame-metal-panel type, also known as the composite body, but welding is also the method chiefly employed for joining the parts. The Edward G. Budd Mfg. Co. of Philadelphia, which sepecialzes in the manufacture of this type of body, uses spot welding largely for the joints of the body panels and has developed a number of "short cuts" which greatly cut down the amount of labor and the time required to complete the job.

Sub-assemblies are put together in jigs and the welding is done while the sub-assemblies are held rigidly in place in these jigs. The sub-assemblies also are welded in jigs. In the main assembly jig, which is very heavy and holds all of the chief structural parts of the complete body, there are large copper bus bars which are used for the spot-welding operation. Where the sheets join together they are flanged, and one of the bus bars lies close to two adjacent flanges while that of opposite polarity runs parallel to it at some distance. The workman uses a sort of copper pry bar as a welding bar. He rests this against one of the copper bus bars and against the sheet steel flange opposite the other bus bar, thus providing a path for the welding current from one bus bar to the other. The sheet steel at the point of pressure of the welding bar will reach welding heat in a very short period and a spot weld is completed in something like a second.

Another method employed by the same firm involves the use of only a single bus bar in the jig, the other electrode being a bar with spade handle attached to a flexible cable, the welding end of which is pressed by the operator against the sheet metal where the spot weld is desired. Lap joints are used to a considerable extent in these all-metal bodies.

On the body of the Overland Six an aluminum bead in strips about three ft. long is secured to the panels by aluminum rivets and the ends of the bead sections are then joined by torch-welding.

Spot welding comes in handy in the manufacture of the running boards. In the case of the Cadillac running boards, three longitudinal members are first spot-welded to three cross members and then these latter are spot-welded to the running board edge bar. The welding is performed on Winfield electric spot welders.

Fenders or mudguards are joined to the fender aprons by seam welding, some manufacturers using the torch and others the electric arc. This is a very long seam and requires considerable time. Sometimes the outer end of the fender bracket is welded to the fender, so as to obviate the necessity for a bolted joint on the outside, which would tend to induce rusting and would also be objectionable because it would introduce an interruption in the smooth surface of the fender. In other cases instead of welding the bracket itself to the fender, a sort of bridge piece is welded to the under side, to which the bracket is fastened by bolting.

There is much welding work also on body accessories such as locks, foot rails, robe rails, window lifts, etc. Cowls are usually welded up of three pieces, the same as seat backs.

Fig. 10—Dust cover of 1/16 in. sheet steel welded to hub stamping of 3/16-in. material in automatic electric arc welder

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ACETYLENE for portable lighting and industrial purposes is generally obtained from steel bottles in which it is dissolved in acetone, the acetone being in turn absorbed by porous earths. H. Stolzenberg, a German chemist, claims to have discovered that another class of organic liquids are decidedly superior to acetone for this purpose. These are the esters, such as diethyl carbonate, which dissolves thirty-one times its own volume of acetylene, whereas acetone absorbs only twenty-five times its own volume. A patent on this process of storing acetylene has been issued in France (No. 583,892 of Jan. 23, 1925).

Fig. 1—Press room of body shop which is lighted adequately by lamps 40 feet above floor. Walls are painted French gray. No drop cords used. Fig. 2—Machine shop of truck plant illuminated to an average intensity of 12 ft. candles. Fig. 4—Body rubbing line illuminated to an average intensity of greater than 48 ft. candles

Lighting System, Like Machinery, Must Be Kept in Good Condition

Correct illumination ranks with men and tools as production factor. Frequent cleaning of windows, bulbs, tubes and reflectors involves expense but is profitable in the end. Various systems are described.

IDEAS or projected plans of industrial enterprise and development usually center around the elements of finance, product, men and plant.

To these a fifth, light, or more definitely, illumination, can very well be added, as every plant must face two specific lighting problems of practically equal importance. One is the question of natural illumination and the other is that of artificial illumination—and a brief analysis will demonstrate that these two exert a profound influence on all of the other four elements.

As to finance, one of the major items on the balance sheet of any company is that portion of the capital account which covers buildings and land. Shall the plant be single story saw-tooth or monitor construction, or be laid out in wings of one or more stories with wall sash? Or will land values demand the combination of small unit floor area and several stories?

On top of this comes another question: Is the plant to be operated during the daylight hours only or is the production great enough to warrant two shifts of 24 hour operation with consequent reduction in the effect of capital charges on the overhead account?

Other Factors in the Problem

Going back of these factors, what about ventilation and heating expense and how will any of these types of buildings affect the cost of putting material through the plant?

Every one of these variables has a definite effect on the lighting requirements and conversely, illumination, either natural or artificial, as related to the types of work and help, is an outstanding factor in the selection and arrangement of structure.

That men must see to produce a good product is axiomatic to the point of platitude but due to mankind's long acquaintence with the sun and the adjustment of the human eye to this light, the characteristics of daylight were taken as a matter of course and it is comparatively recently that light as related to human effort has become the subject of scientific research. This study, stimulated by the present accelerating industrial era, is bringing industrial lighting, both natural and artificial, into the field of exact science and is correcting many of the standards of building construction and lighting installations that were regarded as good practice even as recently as the early days of the automotive industry.

Due to this work the old fashioned prison type building, except where it is a holdover from some former business, has disappeared from the industry and has to a large extent been joined by the carbon filament lamp and its little tin reflector. In the newer plants, wall areas are made up largely of steel sashed windows and single story construction incorporates windows in the roof. The facilities for natural illumination are reinforced by the liberal use of gas filled incandescent and mercury arc lamps while reflectors and diffusers suitable for the individual application are used widely.

Incidentally, illuminating engineers state that on the basis of average foot candles, the automotive industry is about twice as well lighted as the general run of industries in this country.

It is not the purpose of this article to attempt any critical comparisons between the various types of schools of lighting. In Detroit are some plants in which windows have been painted over and artificial light used throughout the working period. In these installations either of the predominant types of artificial light may be used. Body finishing shops are the outstanding examples of this practice and applications of either the Cooper-Hewitt mercury arc lamp or the incandescent lamp with reflectors and diffusers have been made. On the other hand, other plants have made most complete provisions for the utilization of daylight, although these also include adequate artificial lighting equipment to take care of midwinter and unusually cloudy conditions. In other plants both systems are

used during the daylight hours. In every one of these, the chief consideration is adequate light for the work at hand.

Other than the fundamental requirements of adequate light properly distributed to avoid glare and shadows, no axiomatic rules can be laid down for the installation of lighting equipment and each case must be considered in itself. However, illuminating engineers, in both natural and artificial lighting have gone a long way toward making lighting a science and therefore should be consulted when new buildings are to be erected or when old buildings are to be revamped. Practically all of the building, sash and window people maintain research departments which are continually improving their practice, while the electric lamp people and reflector and diffuser companies have embarked upon a tremendous program of research and educational work.

Examples of Modern Lighting

A few examples of modern lighting along with discussion of some of the recent research work will demonstrate the value of careful consultation with illuminating engineers when a plant or department is under consideration.

One of the unusual examples of daylight illumination is the plant of the Holley Carburetor Company. While this building follows sawtooth design, the arrangement is unusual in that the windows in the sawteeth face approximately west and the roof is made up largely of glass tile. Due to the orientation of the building, the intensity of illumination at the floor was found to run as high as 3200 ft. candles on sunny days and the men complained of glare. However the glass tile was painted with glare reducer and the maximum intensity was reduced to 2000 ft. candles.

However, in both cases the minimum intensity was 200 ft. candles, which is a highly adequate degree of illumination. During midsummer glare reducers are used to eliminate heat and glare without hampering illumination. In midwinter, however, the plant is very well illuminated by daylight. In this connection it should be stated that the human eye can work with intensities ranging from 1 ft. candle up. Around noon during midsummer, the intensity out of doors will run as high as 10,000 ft. candles but this is glary. On hazy or partially cloudy days intensities are as high as 5000 ft. candles while clear blue sky without direct sunlight will produce 2000 ft. candles. The two latter figures do not produce intensities which are uncomfortable to the eye.

While intensities of this magnitude are available they are not always apparent in factories in spite of apparent liberal window provisions. In the first place, glass of any kind has an absorbent action which may run as great as 25 per cent. But if the glass is dirty the absorbent action may go as high as 85-90 per cent. With this condition present, with average facilities, the intensity within the shop may easily fall to a point that practically insures poor work and dissatisfied workers. The following table shows the per cent of light transmitted through various glasses before and after cleaning.

Type of glass	Percent of light transmitted Before cleaning	After cleaning
Plain clear	12	88
Fine ribbed (case A).....	14	80
Fine ribbed (case B).....	0.3	75
Wavy wire glass (case A)....	13	80
Wavy wire glass (case B)....	5	75

In the third case, 250 times as much intensity of illumination was transmitted after cleaning.

These figures demonstrate why some plants that apparently have plenty of well located windows are poorly lighted. Judging from appearance, many windows are retained only as mementos of the men who put them in and out of sentiment their condition is not to be disturbed. Granting that it might cost $100 per hour to keep the windows of a very large plant clean, common sense reinforced by simple calculation will demonstrate that this is a profitable expenditure. Later in the discussion of artificial illumination, it will be found that in every case where the intensity has been increased, production has increased, in some cases as much as 25 per cent. While the intensity of artificial illumination does not compare as yet with that of daylight, yet no increase has reached the point where the production curve fell off.

More Light, More Profits

Then assuming that this large plant produces 1000 cars in 9 hr. of daylight and that these cars wholesale at $500 each and that clean windows increase production by 2 per cent, the result is $500 × 20=$10,000—$900=$9,100. Or assuming that the profit per car is $100, a net increase of daily profit of $1,100 is shown. None of the conditions here are exaggerated and the figure of $100 per hr. for keeping windows clean is fairly conservative in the light of experience at some of the larger Detroit plants. It should be understood that this figure includes labor and material involved in keeping windows in repair as well as clean.

The maintenance factor is having some effect on the design of buildings and the choice of glass. Experience has demonstrated that glass in the vertical plane collects dirt somewhat more slowly than when set at an angle in the usual sawtooth roof construction. Furthermore while

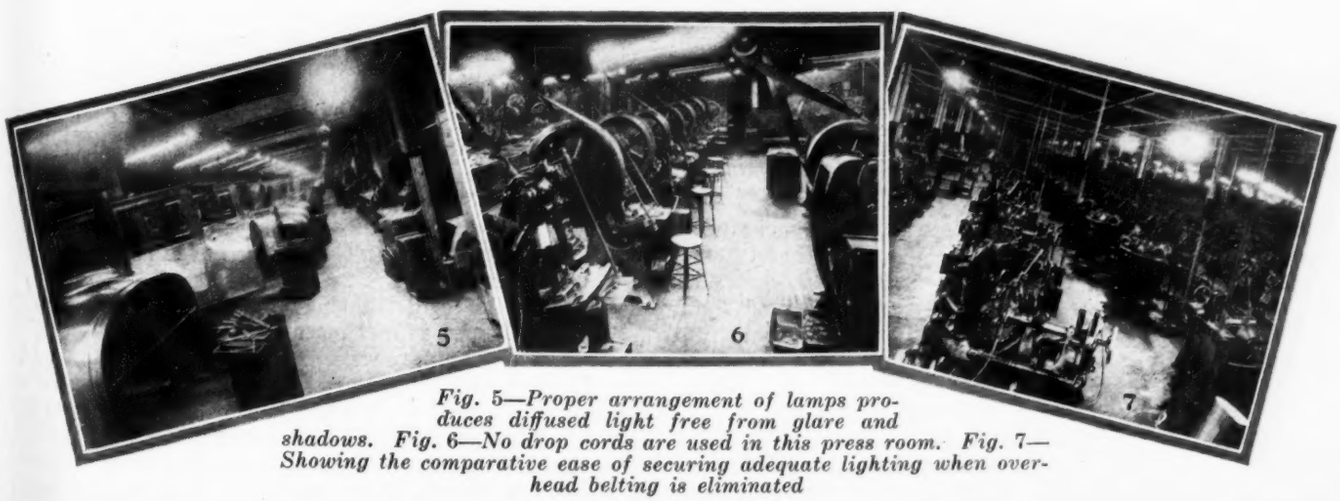


Fig. 5—Proper arrangement of lamps produces diffused light free from glare and shadows. Fig. 6—No drop cords are used in this press room. Fig. 7—Showing the comparative ease of securing adequate lighting when overhead belting is eliminated

the angular sawtooth sash delivers somewhat greater intensity when clean, but little difference is shown between this and the vertical type after the windows have been exposed to dirt. Tests made by W. C. Randall of the Detroit Steel Products Co. have shown the intensity curves delivered by the vertical and inclined sash to be almost identical at the end of exposure periods of three and six months.

But little clear glass is used in wall sash now as this type tends to induce glare close to the wall. Of the diffusing glass, the wavy wire type can stand the most abuse and tends to collect dirt at a rate somewhat lower than that of some of the ribbed glass. In addition, this type of glass can be cleaned on a basis approaching that of clear glass.

In conjunction with the cleaning and glare problems, the Skybryte Company of Cleveland has developed two novel compounds. The first, known as Skyco, is painted on the window as a glare and heat preventative and while the appearance resembles that of whitewash, the coating is impervious to moisture and water at ordinary temperatures but can be washed off with warm water. The second is known as Skybryte and is put up in either powdered or liquid form. When applied, this compound dissolves rust, soot and scale and subsequent flushing with water produces a clean window.

Another angle which is pertinent to the investment problem is offered by sash manufacturers. It is stated that steel sash can be built into a wall at an expense approximately equal to that of the cost of the brick wall. In this statement, the installation of a sill height of about four ft. and the usual pilaster construction is considered. The cost of steel sash per given area is somewhat greater than that of pressed brick but less than glazed brick.

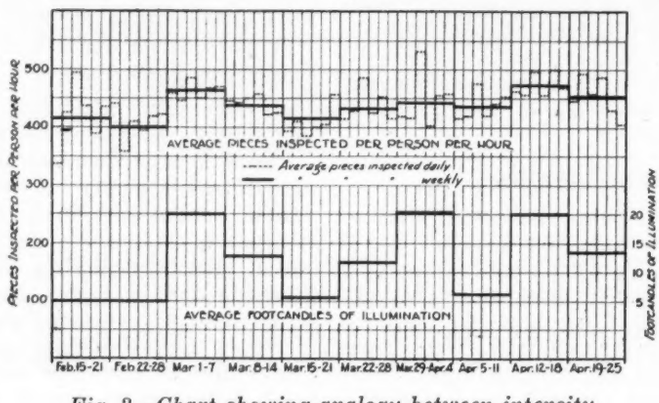


Fig. 3—Chart showing analogy between intensity of illumination and production rate

Higher Intensities Favored

In the artificial lighting field, the general trend is toward higher intensities combined with better diffusion, which not only lights working surfaces but eliminates shadows. The old arrangement of drop cords with glaring lights centered on a relatively small area of the work with the space roundabout in comparative darkness was one of the chief sources of industrial accidents. This condition is entirely comparable to the dimming situation which is causing automotive engineers so much trouble. The visual acuity or nervous reaction under dim light is relatively slow and this condition is aggravated by the fact that the human eye requires an appreciable time interval for adjustment to a greatly modified intensity of illumination.

Fig. 1 illustrates a press room which is illuminated according to modern practice. The original was taken at night with no lighting facilities other than those provided for regular use. In this case the lamps must clear a traveling crane and therefore are located 40 ft. above the floor. The spacing is in 20 ft. squares and 1000 watt incandescent lamps are equipped with X-ray reflectors. Note that no drop cords are used. Walls are painted in French gray and steel work is enameled white. The entire working floor is free of both glare and shadow.

An average intensity of 12 ft. candles is shown in Fig. 2, where drop cords again are conspicuously absent. In this instance 200 watt clear lamps are fitted into Glassteel Diffusers on 10 x 10 ft. centers and are placed 10 ft. above the floor.

In general, illumination engineers attempt to get the lights as high as possible in order to provide a more uniform intensity throughout the room. For extreme heights such as shown in Fig. 1, prismatic appliances such as the X-ray or Holophane are used while in the lower or moderate heights, many appliances such as the Glassteel are used. In general these consist of a porcelain finished reflector which contains not only the lamp but a sanded glass diffuser which eliminates direct glare. The spacing of the lamps depends upon their height and the desired intensity of illumination.

In order to learn the effect of increased intensity of illumination on production, the Timken Roller Bearing Co. and the National Lamp Works have collaborated in a series of tests which were made in the inspection department of the Columbus plant. The results as presented in a paper by D. P. Hess and Ward Harrison are summarized here. The location was the green inspection department where rolls and races are checked for defects and dimension before hardening. Originally the intensity was 5 ft. candles. Tests then were made over a period of ten weeks with intensities of 6, 13 and 20 ft. candles. These with the average production per hr. per inspector were plotted on the chart shown in Fig. 3. The analogy between intensity and production is shown. A summary of the averages for the ten weeks confirms the graph.

Intensity-foot candles	Average pieces inspected per person per hour	Percent increase
5 (Old system)	407	—
6	424	4.0
13	440	8.0
20	458	12.5

The cost of lighting in per cent of payroll ranged from 0.3 per cent with 5 ft. candles of which half was daylight to 0.8 per cent with 6 ft. candles, 1.6 per cent with 13 ft candles and 2.1 per cent with 20 ft. candles. Therefore, at an increase of cost of 2.1 per cent, production was increased 12.5 per cent. Also it will be noted that the production curve rises slightly more rapidly than the intensity curve, indicating the possibilities of still higher intensities.

A number of similar tests are summarized in a paper by Frank E. Carson, from which the tabulation in the box on the next page is taken.

Increasing Illumination Increases Production

All of these bear out the statement that an increase in the intensity of illumination always is followed by an increase in production and that the expense for the additional lighting is relatively small as compared to the additional income.

While incandescent lighting engineers are working to make their lamps approximate the color distribution of daylight, a practically monochromatic light is supplied by the Cooper Hewit mercury arc lamp. This type of illumination is well established in the industrial field and is used liberally throughout manufacturing departments. Here again particular attention is devoted to the absence of glare and surrounding shadows. Due to the mono-

Tests at	Type of work	Average foot-candles Old	Average foot-candles New	Per cent increase in prod.	Cost of addition as per cent of payroll
Pyott Foundry Company	Pulley finishing	0.2	4.8	35	5.0
Foote Brothers	Soft metal bearings	4.6	12.7	15	1.2
Lee Loader & Body Co.	Heavy steel machines	3.0	11.5	10	1.2
Stromberg Carburetor Co.	Carburetor assembly	2.1	12.3	12	0.9
Dolphin Jute Mills	Jute spinning	1.5	9.0	17	no data
General Electric Co.	Semi-automatic buffing	3.8	11.4	8.5	1.8
Detroit Piston Ring Co.	Manufacturing piston rings	1.2	18.0	25.8	2.0
U. S. Post Office Depot	Letter separating	3.6	8.0	4.4	0.6
	Average	2.3	11.2	15.5	1.9

chromatic nature of the light, it is stated that the outlines of small objects are intensified and with proper arrangement of the lamps, obscuring shadows are eliminated.

As in the cases of the other types of illumination, studied care has been given to increasing the intensity of illumination and results in this field confirm every statement which has been made concerning attendant increase in production. Fig. 4 illustrates the body rubbing line at the Chrysler plant and six lamps are placed at a height of 7 ft. in every bay of 20 x 20 ft. with a resulting average intensity of 50 ft. candles and this figure is no doubt very conservative for the intensity at the working surfaces, which are only four to five feet distant from the lamps.

Intensity 32 Ft. Candles

Fig. 5 illustrates another body shop in which the average intensity is about 32 ft. candles. Like all of the illustrations, no additional means of illumination was used when this photo was taken. Note the absence of heavy shadow and the general diffusion of light throughout the entire room. Fig. 6 illustrates a pressroom in the Ternstedt plant in which lamps are placed on 12 x 14 ft. centers with an average intensity of 20 ft. candles. The absence of drop cords is noteworthy. Fig. 7 shows a gear cutting department in which lamps are placed on 14 x 14 ft. centers to produce an average intensity of more than 16 ft. candles.

Earlier in this article the importance of clean windows was emphasized. The same point is true of artificial lighting equipment. Dust on the outside of globes or tubes or on the active surfaces of reflectors and diffusers is not luminous and in fact is a woefully poor transmitter of light and does nothing but cut down the effective area of the lighting source. In the table for windows which is included, it was shown that in one case the effective value of the dirty window was .4 per cent of its possible value. Comparable reductions are possible with any form of artificial lighting equipment.

In some installations the lighting equipment can be cleaned fairly well by the use of an extension air nozzle. In other circumstances, long handled feather dusters will do a fair job but in the end nothing will take the place of periodic washing. And when illuminating engineers and plants in which the increase of intensity has boosted output are satisfied with the soundness of this practice, it seems to be only good business to provide for frequent washing. In order to facilitate cleaning without the hazardous necessity for doing the work at the top end of a ladder, some of the newer lamp installations are being put in as shown by Fig. 8. With any of these arrangements the complete luminaire can be detached and taken to the floor for washing, therefore the cleaner takes up a clean unit and replaces the dirty unit after which the latter is taken down to the floor for the longer washing operation.

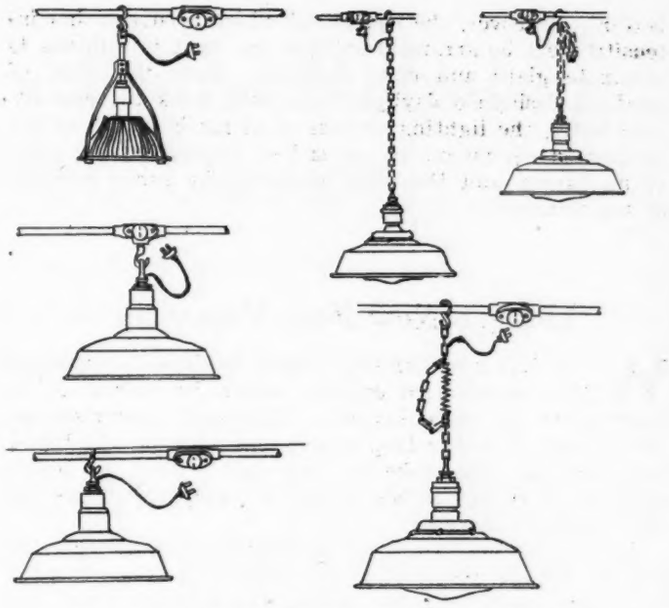


Fig. 8—Five methods of suspension designed to facilitate maintenance

In conjunction with most forms of illumination, the condition of the walls and ceiling is an important factor although recent observations tend to minimize this factor when sawtooth roofs are used. Aside from lighting, clean painted walls and ceilings are conducive to an air of prosperity and well-being which is bound to have some favorable effect on those who work in the building. The French gray of the press shop shown in Fig. 1 is used largely but more often one of the commercial white factory paints is used. Many plants are enameling machine equipment in the lighter colors not only for appearance but to form a contrasting background which will make the tools and parts in process stand out. In some of the most advanced plants, individual electric drive is removing the overhead obstructions which complicate the lighting problems. Two or three of these departments have the appearance of laboratories and the casual critic of shop operation is struck immediately by the clean unobstructed appearance.

The Ventilation Question

Thus far, nothing has been said about the ventilation question which is tied up with the craving for fresh air and spring breezes that seems to be inherent in all classes from the humblest sweeper up. Along with this is the desire to look outside occasionally, if only on the vista of a pile of pig iron. Some shops have taken the bull by the horns by arranging the buildings and windows so that no view of the outside is possible and in some cases artificial ventilation also is installed. In one or two cases labor trouble has followed the installation of the most modern equipment for lighting and ventilation, not because of physical discomfort but in resentment of the changed conditions. Like many other factors in the industrial scheme, this question must be settled by individual conditions and precedents will be found for any course of action.

The same statement applies to the whole question of plant illumination. It is not a subject by itself but is interelated with all of the others and therefore should be accorded proper weight in any industrial development. For given conditions or restrictions, some one system will be capable of producing the best all around results. But any system of lighting must product a high degree of intensity, and based on present practice the higher the

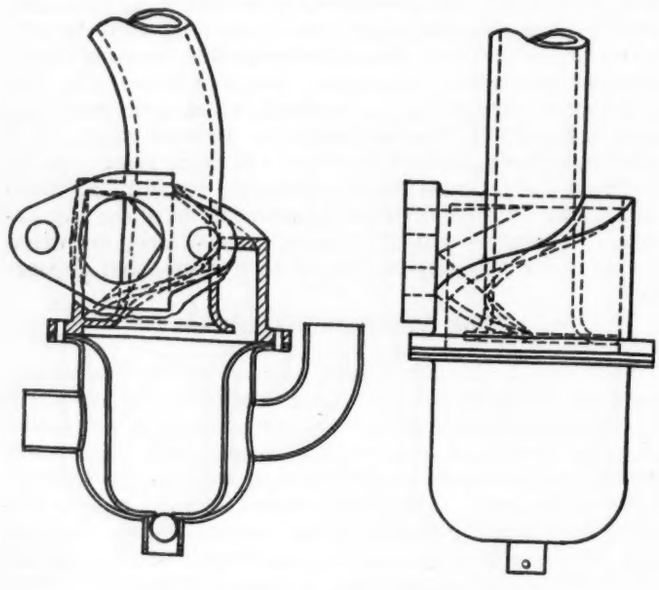
better. Moreover, the equipment which produces this intensity must be arranged so that the light is diffused to eliminate glare and deep shadows. Here the ideal of good old fashioned daylight is a good mark to shoot at. And lastly, the lighting system is as much a part of the production equipment as are lathes, presses or any piece of machinery and therefore requires the same measure of maintenance.

Designs New Fuel Vaporizer

W. H. HILL of Canton, O., has developed a vaporizer for automotive engines which he claims to be superior to the usual hotspot. The outfit comprises an inlet manifold with a trap which separates out the liquid fuel, and an exhaust-heated cup into which the liquid particles drain and in which they are evaporated, the cup being exhaust-jacketed.

As may be seen from the accompanying drawings, the T-type of inlet manifold at its lower end is surrounded by a cylindrical chamber, which the mixture from the carbureter enters tangentially. This causes the mixture to swirl around in it, throwing any unvaporized particles of fuel against the outer wall, to which they adhere. The entrance to the inlet manifold is centrally at the bottom of this chamber and can be reached only by fuel in the gaseous state or at least in a very fine state of division.

At the bottom of the swirling chamber is located the vaporizing cup which is provided with a jacket for the exhaust gas to circulate through. The cup itself, as well



Two views of the Hill fuel vaporizer

as the jacket, is made of a sheet metal drawing, and the fittings for the admission and discharge of the exhaust gas are electrically welded to the jacket.

The vaporizing cup absorbs heat from the exhaust gases and is raised to a considerable temperature. Some of this heat is conducted to the wall of the adjacent swirling chamber, and according to the inventor there is a gradual temperature increase from the top of the swirling chamber to the lower part of the vaporizing chamber. For this reason the lighter fractions of the unvaporized gasoline are vaporized in contact with the wall of the swirling chamber, while the heavier fractions run down this wall and come in contact with surfaces of gradually increasing temperature, until their dewpoint is reached, at which they also are vaporized.

Among the advantages claimed for this device is that none of the raw gasoline delivered by the carbureter during starting can get into the engine cylinders. The fuel is vaporized not by contact with a relatively small and excessively hot area, which often results in cracking, but by a differential action which removes the lightest constituents first and brings the remainder in contact with surfaces of increased temperature, until they are vaporized also.

THE Moreland Motor Truck Co. has developed two bus bodies for mounting on their six wheel chassis. A double deck 60 passenger model and a single deck 29 passenger model.

The double deck bus has service brakes on all six wheels operated by compressed air instead of the combination hydraulic-air system formerly used. Air is stored in two tanks and connected to the pump located at the right front side of the motor. A brake area of 1300 sq. in. is provided on the six brake drums. The hand operated emergency brake operates on the four drive wheels only. Brakes on the single decker are self energizing mechanical type on drive wheels for service use with emergency brakes similar to those on the double decker.

The six cylinder Continental motor has been improved and now develops 105 hp. at 2000 r.p.m. Other features of the buses are all pressed steel frames, pilasters, roof truss, crown sheets, window cases and garnet rails. Sides, front and rear, are of Plymetl and the roof of Haskelite. Side sections are removable and interchangeable. Radiator is sectional, with each section removable, and is suspended by a three way adjustment to relieve frame stresses. The cam and lever steering gear has accelerated action when rounding corners.

The six wheel chassis and engine was described in *Automotive Industries* for Feb. 19, 1925, and June 4, 1925.

WEAR resistance of gage steel appears to increase with the quenching temperature, but unfortunately the liability of the gages to crack on quenching also increases with this temperature. If means could be found to avoid cracking when quenching from a high temperature, the wear resistance of gages could be increased, and the Bureau of Standards, collaborating with the Gage Steel Committee, has investigated one particular type of gage steel to determine the generation of internal stresses on quenching.

WHEN barrels are piled two or more tiers high, those at the bottom are subjected to considerable pressure by the weight above. The barrel staves, therefore, often become distorted, particularly if the barrels are stored for a considerable length of time, and leakage results. Subsequent shipment of the barrels by truck or freight usually aggravates the leakage.

To make it possible to avoid loss from this cause, the Revolvator Co. of Jersey City, N. J., has brought out a barrel rack made of section steel. The use of such racks relieves the barrels of all strains beyond that due to their own weight, and it is claimed that the racks, together with the revolvator, a type of portable elevator, greatly facilitate the storage of barrels in and their removal from warehouses.

Heat Conservation a Prime Requisite in Drying Oven Design

Labor saving factor also should be considered as well as the use of panel or unit construction to facilitate moving if necessitated by plant changes. Kiln, intermittent and continuous conveyor types.

By P. M. Heldt

AUTOMOBILES are constantly exposed to the weather, and as the chief materials of construction used in them—steel and wood—are subject to attack by atmospheric agencies, it is necessary to give them a protective coating. Practically all of the metal parts that must be thus protected are given two or more coats of japan and are baked after the application of each coat, in ovens, at a temperature of approximately 450 deg. F.

The car body, on the other hand, although its panels are made of metal, usually contains a good deal of wood in its make-up, which is incapable of withstanding the high temperature of the baking process without deterioration and therefore must be finished in a different way. The process usually employed involves the application of a considerable number of successive coats, each of which must be allowed to dry before the next one can be applied. The drying process can be materially expedited by the application of heat, even though the permissible temperatures are much more limited than in the case of japan, and oven-drying is generally practiced.

Large Ovens Recent Development

Drying and baking ovens thus have become an important item of equipment in automotive manufacturing plants, and great advances in the design and equipment of these ovens have been made in recent years. While the general type of oven has been used in the industries for a long time, for baking foundry cores, armatures and other electrical units, bicycle frames, etc., the earlier ovens generally were designed to handle parts much smaller than an automobile chassis or a body, for instance, and the quantity of material passed through them in a given time was much less, so that economy of heat and of labor in handling the material passing through was less urgent. Possibly the conditions of competition obtaining in the automobile industry, which makes the very existence of the firms in it dependent upon reduction of all production costs to the lowest possible figure, have had their effect in speeding this development.

Drying ovens as used in the automotive industry may be divided into three general classes:

The first is the kiln or cabinet type, in which the work is placed in the oven directly by hand or on trucks which are wheeled into it.

The second class is the intermittent or semi-continuous type, with which the work is loaded onto a mechanical conveyor which is moved forward at intervals as one batch has been baked and another is ready to enter the oven.

The third is the continuous conveyor oven, in the case of which a mechanical conveyor moves through the oven continuously, the work being placed on the conveyor as it enters and removed therefrom as it leaves the oven. This latter type of oven is usually combined with a dipping and dripping compartment or forms a continuation of the department in which the protecting coats are applied by spraying or flowing.

A very important consideration in the design of drying ovens is heat economy or heat conservation. When it is considered that in japanning the temperature of the oven must be in the neighborhood of 450 deg. F., and that in an automobile assembling plant the drying ovens occupy a very considerable fraction of the total floor area, it will be realized that the opportunity for wasting heat is great. In order to prevent loss of heat through the walls of the oven, they are now always made of some heat insulating composition, such as magnesia or asbestos block, the thickness of the walls being increased with the temperature at which the oven is to operate.

Owing to the frequent enlargements and reorganizations of manufacturing plants in the automotive industry, it is quite desirable that the design of the oven be such that it can be taken down and re-erected in some other place, or enlarged, without too much labor being required. This has led to the widespread adoption of the panel or unit construction, somewhat similar to that employed in portable buildings. The floor and the side and roof panels can be joined together by some method usually original with the particular oven manufacturer, and ovens of widely different size can thus be built up from standard sized panels. These joints are the distinguishing characteristics of most of the ovens, and in their design considerable ingenuity has been displayed.

According to figures given by the manufacturers of heat insulating materials, steel has a conductivity for heat of over a thousand times that of some of these materials, and for this reason the use of "through" bolts or of other metal parts extending from the inside to the outside of the enclosing walls is highly undesirable. Some other method of joining the panels together than by the ordinary bolted construction must therefore be used.

Heat Storage Capacity of Walls

Oven walls should have a minimum heat storing capacity. This is particularly important in the case of ovens which are loaded and unloaded at intervals, which drop greatly in temperature during the loading and unloading period. If the material of the walls had a high specific heat, obviously a great deal of heat would be required to bring them to the operating temperature each time, and this heat would be entirely wasted. This means that in the case of the insulating materials, not only their resistance to heat flow, but also their specific heat must be considered. Furthermore it is an advantage to use an inner metal case of comparatively light gage, as the ex-

posed metal naturally gives up its heat most readily and cools most rapidly.

Another requirement is that the joints be air-tight and remain so in use. This is important not only because any leakage of the hot air through the joints of the roof, for instance, would reduce the efficiency of the oven from the thermal standpoint, but because as a result of the system of air circulation usually maintained, dust-laden air would be drawn in through some of these leakage cracks and the dust would spoil the finish.

The various requirements determining the structural details are by no means easy to meet. The oven must have sufficient strength so that there is no danger of the panels sagging and bulging and the whole structure collapsing. The joints must remain air-tight in spite of the considerable heat expansion due to increase in temperature. There must be no "through" bolts or similar metallic retaining parts; the friable insulating materials must not be exposed on the inside of the oven; they would be likely to form dust which would stick to the coatings of japan, varnish, etc., and thus spoil the finish, and the joint, while secure, must still be easily broken.

Interior Lining of Sheet Steel

In order to provide a smooth interior surface that will not give off any dust and that can be easily kept clean, the walls usually are given an interior lining of sheet steel. Sometimes the panels of insulating material also have an outer sheathing of steel and the steel sheet then forms a casing for the insulating block and an integral part of the panel. In other cases an outer coating of asbestos cement, applied to a foundation of expanded metal lath, is used for the outer covering, over the block of insulating material. In the following the panel construction and joints used by different oven manufacturers will be briefly described.

The bolt-less joint used by Young Brothers Co. of Detroit is shown in Fig. 1. The panels in the particular case illustrated are of 4 in. insulating material with a covering of sheet steel with a copper content which prevents or retards corrosion. The edges of the panel are set in a channel section frame provided with a lining of sheet asbestos, and the ends of the sheet metal cover are seamed over the flanges of the channel. Of the two adjacent channels one has the flanges taper outwardly and the other inwardly, and one channel fits over the other, forming a telescoping, flexible, self-sealing joint. The two channels together form a tubular space which is filled with a special form of pulverulent joint insulation. In the Young Brothers oven the roof is supported from the side walls through the intermediary of rolled steel angles as shown in Fig. 2. These are bolted to one flange of the top channel of the side wall, but the bolts are completely surrounded by joint insulation. The roof panel is secured

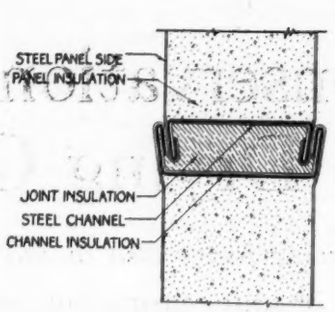


Fig. 1—Telescoping joint of Young Brothers oven construction

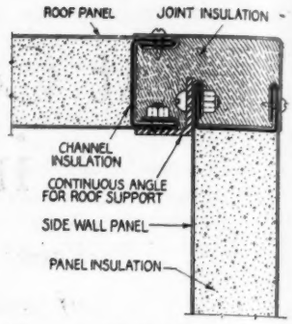


Fig. 2—Method of supporting roof of Young Brothers oven

to the angle steel by bolts with countersunk heads, and after the space formed by the channels of the roof and side panels is filled up with joint insulation, the latter is covered by an angle strip of sheet metal held in place by wood screws.

An important feature of the Gehnrich industrial ovens, made by the Gehnrich Indirect Heat Oven Co., Long Island City, N. Y., is the binding member by which the panels are joined, which is illustrated in Fig. 3. This is of H form made of pressings of sheet steel with a lining of asbestos fabric. Although some of the metal of this binding member is exposed on the inside and some on the outside of the oven, none extends through from the inside to the outside. The joint between the side walls and the roof is formed by extensions of the sheet metal coverings of the panels, as shown in Fig. 4, the roof resting on the side walls with a strip of asbestos fabric between. Special angle sections of insulating material are used for the corners, so no corner joints are required. The corners are re-inforced by angle irons to which is riveted the outer sheet metal covering of the panels, and these vertical angle irons are joined togther above the oven by tie-rods. By means of these tie-rods the panels can be drawn close together, and the joint will become tighter as the oven is heated, because the panels are heated and expand, while the tie-rods change little in temperature.

The panels of the ovens built by the Paul Maehler Co., Chicago, Ill., are made up of blocks of insulating material measuring 12 by 36 in., and either 2½ or 4 in. in thickness. Either Cil-O-Cell, Nonpareil or J.M. 85% magnesia is used for the blocks. These blocks are grooved longitudinally along their edges, and asbestos joint tongues are fitted into the grooves (see Fig. 5). Before being placed in the panels the blocks are grooved and treated, then cemented and they are pressed into the metal casings by means of a ramming machine developing a high pressure. It is claimed that by this process the blocks become so firmly bonded that it is impossible to detect the joints, and that the completed panels are rigid and accurate in dimensions.

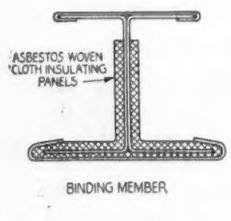


Fig. 3 — Binding or joint member of Gehnrich oven

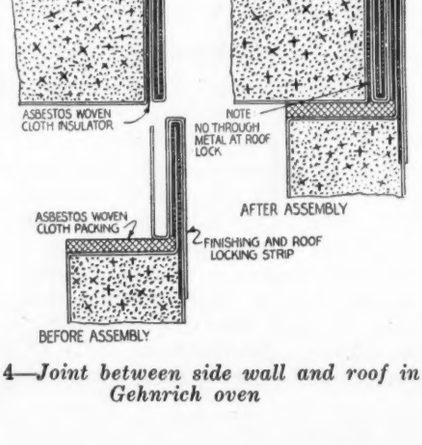

ASBESTOS WOVEN CLOTH INSULATOR
NOTE NO THROUGH METAL AT ROOF LOCK
AFTER ASSEMBLY
ASBESTOS WOVEN CLOTH PACKING
FINISHING AND ROOF LOCKING STRIP
BEFORE ASSEMBLY

Fig. 4—Joint between side wall and roof in Gehnrich oven

Maehler Oven Construction

In the Maehler oven the roof is supported on the side panels through the intermediary of sealing strips of sheet asbestos which is compacted by the weight of the roof. On top of the roof is placed a frame of angle irons. These roof angles are secured to the vertical angle irons extending up the sides of the oven by means of bolts, holes for the bolts being drilled in both sets of angles in advance so as to match and cause the roof and side panels to be perfectly aligned when the bolts are drawn up. The floor of the kiln type of oven is usually made of 2½ in. insulating blocks molded into panel form, with truck rails recessed in to correspond to the factory

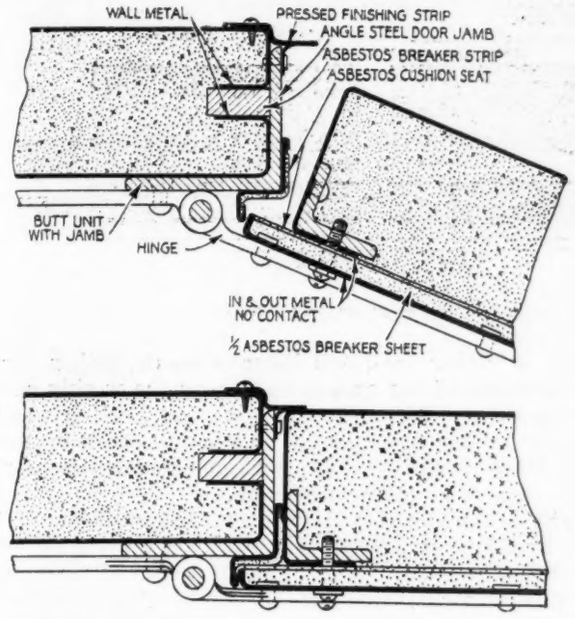


Fig. 5—Details of Mahler oven construction

floor. The roof is made with relief covers in accordance with recommendations of the Insurance Underwriters.

Joints at corners are done away with by employing molded corner pieces of insulating material. The door frames (Fig. 6) are made of either 3 or 4 in. angle steel in a single piece. The doors also consist of blocks of insulating material, with frames of lighter angle steel. A ½ in. layer of asbestos is placed over the sheet steel on the outside of the insulating block and this in turn is covered by a layer of No. 14 heavy galvanized sheet steel. The asbestos and sheet steel outer casing are allowed to project 1¼ in. beyond the edge of the door all around. When the doors are closed this asbestos strip seats against a corresponding strip, fastened to the door frame, thus forming a cushion joint which under the pressure of the door fastening device effectively seals the door.

A departure in oven construction has been made by the Detroit Sheet Metal Works in their DSM oven, in which a structural steel frame is incorporated in the walls. The roof is carried on steel bars supported at each end by steel posts in the oven wall joints. Inner panels, consisting of blocks of insulation pinned into the sheet metal inner casing at the vertical rib, are assembled against the steel frame so as to form a flush inner surface of sheet steel, while the surfaces of the floor and roof also are flush. The joints between the steel panels are interlocked and form ribs which stiffen the entire structure crosswise. Lengthwise the oven structure is braced by angles and V strips riveted on. Into the steel panel is laid the block of insulation, which is of full panel size. The rib of the metal panel extends only half way through the insulation and there is no metallic connection between the inner and outer casing of the oven wall, if the outer casing be metallic. The outside casing may be either of sheet metal or of asbestos plaster, which latter is applied to a foundation of expanded metal lath secured by clips to the metal frame work. In case a steel outer casing is to be used it is made up in panels, the same as the inner wall, but without the structural elements, as this casing has no load to support. In most ovens the ribs in the side walls are spaced 18 in. and the large number of ribs adds to the rigidity of the wall.

In order to make the joints between the sections of the sheet metal casing air-tight, the joint portions of the sheets are coated with rubber cement. The seams are then formed and after the oven is started in operation the rubber is baked and forms an air-tight joint, it is claimed.

A special wall construction is employed in ovens recently installed in various assembling plants of the Chevrolet Motor Co. and was described in a S.A.E. paper by Gordon Lefebvre. Referring to Fig. 7, the inner shell is formed of No. 22 gage standard width sheets, the edges of which are broken to form 2 in. double lap-joints with the adjacent sheets. The sheets are joined, riveted through the laps and erected in a vertical position with respect to the joints to give structural strength. The inner shell of the floor and the roof is formed in the same manner, except that in the case of wide ovens it is necessary to add stiffening strips to each lap-joint to carry the weight. Two inch block magnesia is laid against the outside of the sheets and fitted tightly between the joint flanges. Small holes are punched in the joint edges 12 in. apart, and short lengths of No. 16 annealed wire are inserted. The wires are twisted once and the two ends are left free. Expanded metal lath is laid against the magnesia block, with the ribs horizontal, to check convection currents. Annealed wire is used to fasten the lath, a short length of wire being left exposed beyond the lath. Against the lath is laid another layer of magnesia block which is 1 in. thick in the case of low temperature (body drying) and 3 in. in the case of high temperature (japanning) ovens. Over this outer layer of magnesia 2 in. mesh poultry netting is tightly drawn and secured with the protruding ends of the annealed wire. A ½ in. coat of asbestos plaster is applied over the netting and a finishing coat of half and half asbestos and cement plaster, which completes the oven wall.

Heating Systems

In drying coats of varnish only comparatively low temperatures are permissible, of the order of 120-150 deg. F., and with ovens for this purpose the heat is generally supplied by steam coils or radiators. This applies also to coatings of pyroxylin base lacquer, which are generally allowed to air-dry, while in some cases, particularly in the finishing of bodies for low-priced cars, are dried in ovens maintained at a mild temperature. For baking ovens, however, it is impossible to get a sufficiently high temperature from steam, and some other kind of heat supply must then be used. For core baking ovens it has been the general practice to use either coal or coke as fuel, but for drying coats of paint, varnish or japan, the use of liquid or gaseous fuel or of electric heat has been found preferable.

With liquid or gaseous fuel two different methods of heating are available, the direct and the indirect sys-

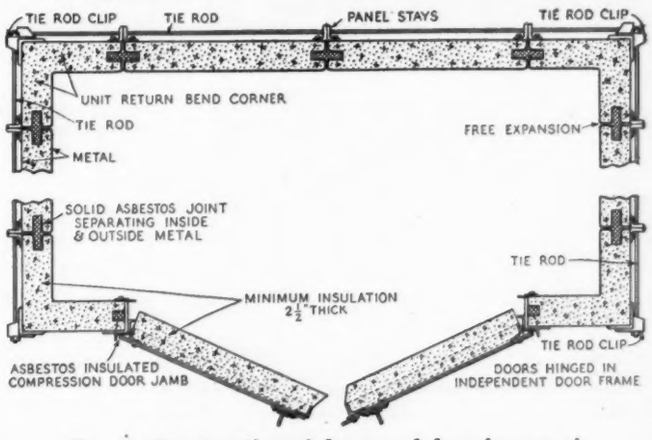


Fig. 6—Construction of doors and door frames of Mahler oven

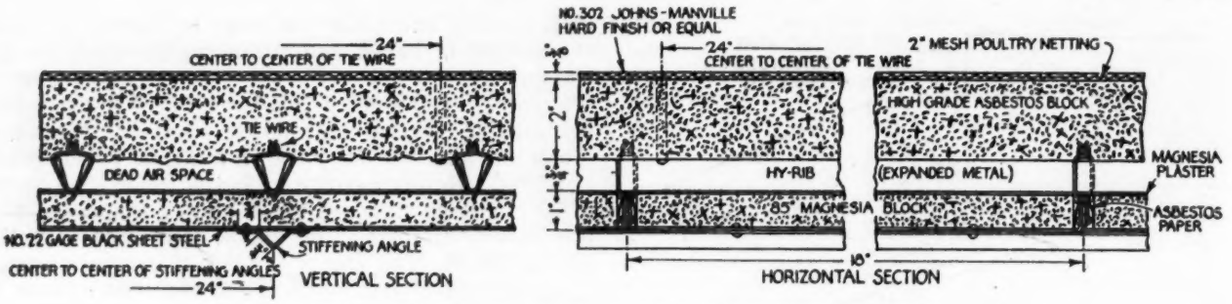


Fig. 7—Form of wall construction used in late Chevrolet drying ovens

tem. With the direct system the gases of combustion are admitted into the drying chamber, and this system has the advantage from the standpoint of thermal efficiency, as well as from that of low first cost. The greater economy, however, is offset by the fact that the atmosphere within the drying chamber will contain particles of soot which are apt to impair the quality of the finish obtained, and that the fire and explosion hazard is increased, because flame is always present and if for any reason the content of vapors of the solvent should become sufficiently great to form an ignitable mixture, all the elements necessary for an explosion would be present. Usually, however, if an ignitable mixture forms anywhere in the oven it is fired almost immediately, and the result is merely a flash-up instead of a serious explosion. It is probably chiefly on account of the lesser degree of cleanliness that the direct heating system is used only where the highest quality of work is not required and where very quick drying is not necessary.

Electric Heating

In the majority of paint drying and japanning ovens now used in the automotive industry either the indirect oil or gas or the electric heating system is used. With the electric heating system heating units are secured to the walls of the ovens in such positions as to assure the best possible temperature distribution. The electrical system is ideal from the standpoint of heat control and has a number of other advantages. Naturally, however, electrical heat is rather expensive, even when electrical energy is supplied for as low as 2 cents per kilowatt hour, and another objection that has been raised against the electric system is that the ribbon of the heating units is rather frail and becomes easily broken through carelessness of the operatives during the weekly cleaning of the ovens. The electrical system of heating was thoroughly covered in an article by Wirt B. Scott, in *Automotive Industries* of Nov. 20, 1924, and its advantages therefore require no elaboration here.

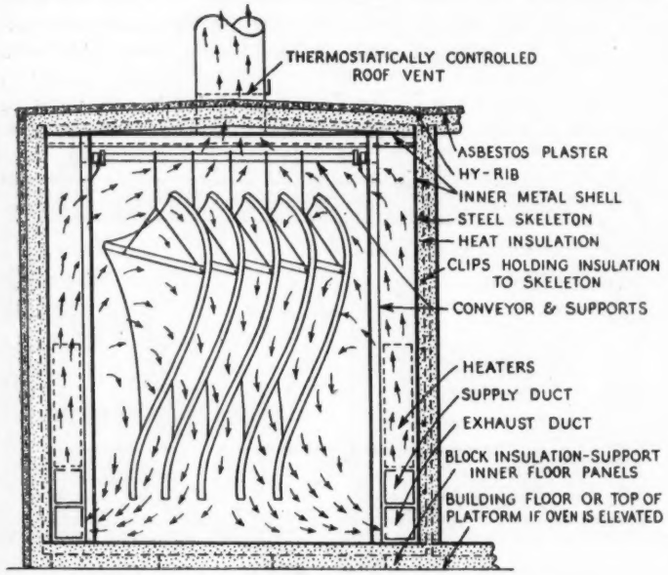


Fig. 8—Illustrating Duo-Vent ventilating system of DSM oven

The heaters employed with the direct system of heating by liquid or gaseous fuel work on a principle similar to that of a steam boiler. The air is forced through coils of pipe located inside the burner housing, absorbs heat from the flame and hot gases, and is then carried through an air duct into the oven. This duct usually extends lengthwise through a considerable part of the oven and has a number of damper-controlled outlets, by means of which the distribution of temperature and also, to a certain extent, the circulation within the oven can be regulated.

Ventilation of drying ovens is required chiefly for two reasons. If no ventilation were previded the vapors from the solvents of the protective coating would accumulate and eventually would form with the air an explosive mixture, which would involve considerable danger. Another reason for renewing the atmosphere in the oven is that the oxygen of the air is consumed in oxidizing the vegetable oils of the paint or japan, and if the air should become appreciably poorer in oxygen the oxidizing action would undoubtedly be retarded. For these reasons the air in the oven is changed from 15 to 30 times per hour.

Circulation induced by a ventilating system, moreover, helps with the equalization or regulation of temperature throughout the oven, a highly important feature. On the other hand, allowing air to escape from the oven at a temperature of say 150 deg. F. or more, at the rate implied by 15-30 complete renewals per hour, is a serious source of loss, and one company at least re-circulates the air. The blower of the ventilation system is arranged with a double inlet admitting fresh air and air from the vent of the oven, respectively, both inlets being provided with dampers so as to make it possible to vary the proportion of fresh to re-circulated air. This would seem to indicate that conditions of temperature equalization call for a more rapid circulation of the air than the devitalization of the air by the oxidation process and the danger of forming an explosive mixture by the admixture of the vaporized solvents with the air.

DSM Ventilating System

What is known as the Duo-Vent ventilation system is used in the DSM oven of the Detroit Sheet Metal Works. As shown in Fig. 8, fresh air supply ducts extend along both side walls of the oven near the floor. The heaters, which are located over the supply ducts, cause the air to rise to the ceiling, where it diffuses and cools, and it then descends through the center of the oven to the floor line. As the air reaches the floor line it is drawn out through the exhaust ducts located along both side walls underneath the fresh air ducts. During its descent the air

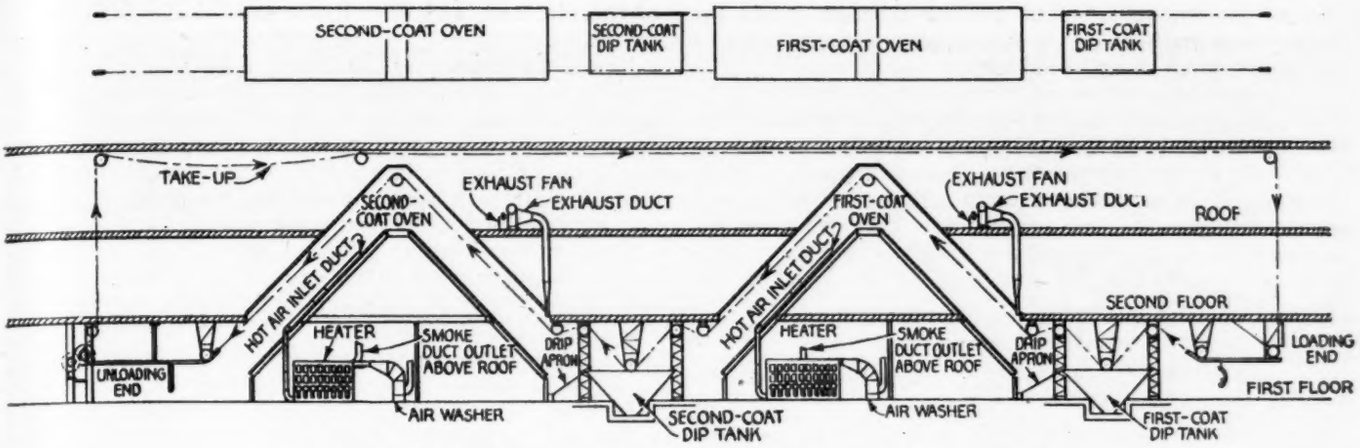


Fig. 13—Diagram of continuous type japanning oven for two coats

necessarily picks up any vapors in the oven and carries them out with it. It is claimed that with this system the temperature difference between the air at the floor and at the ceiling does not exceed 10 deg.

The Detroit Sheet Metal Works state that in a continuous type drying oven there are really three zones, referred to, respectively, as the condensation zone, the smoke zone and the drying zone. As the work enters the oven, because of its low temperature, it has a tendency to condense the vapors, and to prevent this, a considerable amount of heat must be supplied here, which involves rapid circulation of the air. As soon as the work attains a certain temperature the volatiles begin to evaporate and smoke to form, which latter should be removed rapidly. In the final, the drying zone, the air circulation need not be very brisk.

The Drying Process

The drying of coats of paint, varnish and japan is a somewhat involved process and cannot be directly compared with the drying of water-wet articles. Of course, all of these finishing materials contain a solvent which is driven off by evaporation during the drying process. In addition, however, paints contain a great deal and japans a smaller amount of linseed oil which is not evaporated but oxidized. At first throught it might be supposed that absolutely dry air would cause a coat of paint or varnish to dry most rapidly, but freedom from moisture does not even expedite the evaporation of the solvent, owing to the operation of the law of partial pressures, according to which the rate of evaporation of any fluid depends solely upon its vapor tension and upon the partial pressure of its vapors in the surrounding atmosphere, and is entirely independent of the content of other vapors in the atmosphere. But the process of oxidation of the linseed and other oils is greatly accelerated by the presence of moisture in the air, and it is therefore common practice in paint drying installations to humidify the air entering the drying ovens.

The amount of moisture which air will hold without becoming foggy varies with the temperature. If the air contains the full amount of moisture it will hold at any particular temperature, the humidity is said to be 100 per cent, and if the moisture content is less it is expressed in percentage terms. Different finishing coats require different degrees of humidity for their most effective drying, which has to be determined experimentally, and the humidifiers used in connection with the drying system are then regulated so as to provide this degree of humidity.

Another requirement is that the air entering the oven be practically free from dust particles, as these would settle on the coated surfaces and form specks. Therefore, before the air is admitted to the drying oven it is passed through an air washer.

Engine cylinder blocks are now generally painted and oven-dried. At the plant of the Cadillac Motor Car Co. in Detroit the cylinder castings are painted by spraying, all parts not to be covered with paint being protected by caps. They are then baked for two hours in a steam-heated oven with gravity conveyor at 240 deg. F. At the Detroit plant of the Continental Motors Corp. cylinder blocks after painting are dried in a continuous chain conveyor type oven, and an illustration of the oven, installed by Young Brothers Co. of Detroit, is shown herewith (Fig. 9). This oven is 52 in. wide, 62 in. high, and 60 ft. long. With these tunnel type ovens it is customary to use curtains at the openings which are cut out to just let the objects carried by the conveyor pass; in the photograph no curtain is shown, and it was evidently removed before the picture was taken. In this oven the direct heating system with gas fuel is employed.

Complete chassis now are generally dried after painting in continuous tunnel type ovens, the conveyor used being of the double chain type and the chassis being moved through the oven sideways. The temperature used in drying the paint coat on chassis is usually between 140 and 150 deg. and steam can be conveniently used for heating.

Undoubtedly one of the most interesting applications of ovens in connection with the automobile industry is in baking the coatings of japan on such sheet metal parts as fenders, aprons, cowls, etc. One of the smaller cars in production has eleven sheet metal parts finished by japanning and fourteen small parts, the total weight of metal in these parts being 150 lb. The weight of metal plays an important part in the baking process, because the amount of heat required depends much more on this than on the area of the japanned surface. In fact, a practice has arisen of calculating the efficiency of an oven on the

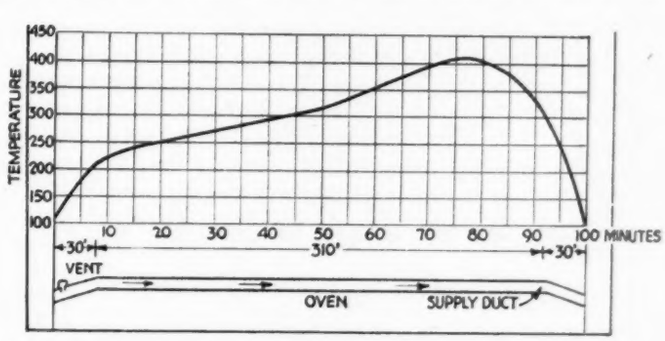


Fig. 14—Diagram showing variation of temperature along a Drying Systems, Inc., continuous type oven with inclined ends

basis of the amount of metal passing through it and the temperature gradient on the one hand, and the amount of heat units supplied on the other.

As already pointed out, in japanning, the dipping apparatus, the arrangements for collecting the drippings from the dipped parts, and the drying oven usually form a complete unit. In most instances the sheet metal parts receive two coats of japan and two units comprising each a dip tank, a drip pan and baking oven are therefore arranged in tandem, but in some of the higher grade cars more coats are given, five, for instance, in the case of the Packard.

An Intermittent Type of Oven

An intermittent type of baking oven is installed at the plant of the Federal Motor Truck Co., the oven being of Young Brothers make. As shown in Fig. 10, a mono-rail type of conveyor is used and there are two ovens side by side. The mono-rail track forms a complete circuit through the two ovens or compartments and at the ends outside the ovens passes over the dip tanks and drip pans. So-called carriers, onto which the parts to be japanned are hung, are suspended from the mono-rail by trolleys. A section at the center of the curved portion of the mono-rail is so arranged that it can be raised and lowered by means of an air hoist.

As a carrier comes out of one of the ovens the baked parts are removed from it and new, properly cleaned and dried parts are hung on. Then the carrier is moved around to the free section of the mono-rail, which is lowered to dip the parts into the japan tank below. After the parts have been hoisted out of the dip tank the carrier is moved forward over the drip pan, which latter drains back to the dip tank, as shown in the photograph. Usually there are two or three carriers in each oven while one is over each drip pan and one is being loaded and unloaded. The dip and drip for the second coat are at the far end.

It is interesting to note that this particular oven was originally designed as a truck type oven but was changed over to an overhead trolley type, with considerable increase in production and undoubtedly some improvement in the thermal efficiency.

The conveyors used with the continuous systems of japanning and baking sheet metal parts are of the double chain type, the parts being hung onto steel tubes extending crosswise through the oven from one chain to the other. The conveyor passes over chain wheels at the ends of the oven and returns over the top of same, being driven by an electric motor installed in a convenient location. Details of the dip tank, drip pan and conveyor may be seen from Figs. 11 and 12.

One problem with all continuous or conveyor ovens is to prevent excessive loss of heat through the ends, which remain open continuously. This has been solved by the adoption of ovens with downwardly inclined end sections. Hot air naturally tends to rise to the top, and there is, therefore, a natural tendency for the heated air to rise to the center section, rather than to flow to the ends of the oven and escape, but as a further assurance against heat loss through the ends, loading and unloading are generally done in closed rooms with double doors, in which rooms a slight over-pressure is maintained by the ventilating system. Some of the latest of these conveyor type ovens consist only of two inclined sections, which has the advantage that the required over-all length is materially reduced.

Such an installation for applying two coats of japan to sheet metal parts and baking them is shown in diagram in Fig. 13. At the loading end the conveyor follows a horizontal path for a certain distance, where the parts to be enameled are hung onto it. Then it rises to clear the edge of the dip tank, and next it descends to dip the parts in the japan.

The tanks necessarily are of very large size, of angle and sheet steel riveted construction, as shown in Fig. 12, and contain a large quantity of the inflammable japan. In order to insure an even, smooth coating, the japan must be clarified either at intervals or continuously. Clarification is sometimes accomplished by means of fine mesh strainers or by a filter press, but recently it has become a more common practice to use centrifugal clarifiers which work continuously, throwing any solid particles of higher specific gravity than the japan to the outside of the filter, while the purified japan is drawn off at the center. Unfortunately these centrifugal clarifiers cannot be used with japans containing a pigment, for obvious reasons.

In order to provide protection against disastrous fires, a fire tank is installed underground, underneath the dip tank, and a valve locked in the closed position by a fusible link similar to that used in fire doors, in case of fire will quickly empty the dip tank through a large diameter pipe into the underground fire tank.

In some cases use is made also of mixing tanks located higher up than the dip tank. In this mixing tank solvent is added to insure the right viscosity of the japan (as determined by viscosimeter tests), and the supply in the dip tank is added to from time to time from this mixing tank.

As the conveyor leaves the dip tank, to clear the edge of which it must rise to a considerable height, it enters the space over the drip pan, where it may either rise or descend, according to the direction of inclination of the pan.

When the parts enter the first inclined section of the oven and are heated up, a secondary run takes place, owing to the reduction of the viscosity of the japan with increase in temperature. This secondary run can be reduced by starting with a moderate temperature and increasing as the parts ascend the incline; otherwise the finished surface will show imperfections. One method of taking care of the japan from the secondary run is to cover the bottom of the first part of the oven with tar paper, which can be burned up after it has accomplished its service.

Details of Inclined End Ovens

Ovens with inclined sections usually have the openings below the ceiling of the first floor, while the central section is either on the second floor or extends through the roof of the building. There is, of course, a considerable amount of space under the central section of such an oven, and this is generally utilized for the installation of the heater. From the heater a hot air duct enters the oven near its exit and passes through the oven in the direction opposed to that of conveyor motion, to near the center thereof. Sometimes all of the hot air is discharged at this point, while in other cases it is discharged through a number of outlets in the duct which are individually controllable by means of dampers.

Heated air thus enters the oven near the upper end of the descending section; it will pass down the decline a certain distance, but not all the way to the outlet, and it will also pass over the summit and down the incline, but not all the way to the inlet. As soon as the dipped parts get into the heated atmosphere the solvent begins to evaporate, and by looking into the oven from the end one can clearly observe the formation of clouds of the vapor. All of the solvent is driven off in a short section of the oven and beyond that the atmosphere is clear again.

At the point of vapor formation is connected an exhaust duct through which the vapors are drawn off by means of an exhaust fan located in the upper part of the building and discharging above the roof. As the parts approach the exit of the oven they are subjected to an increasing

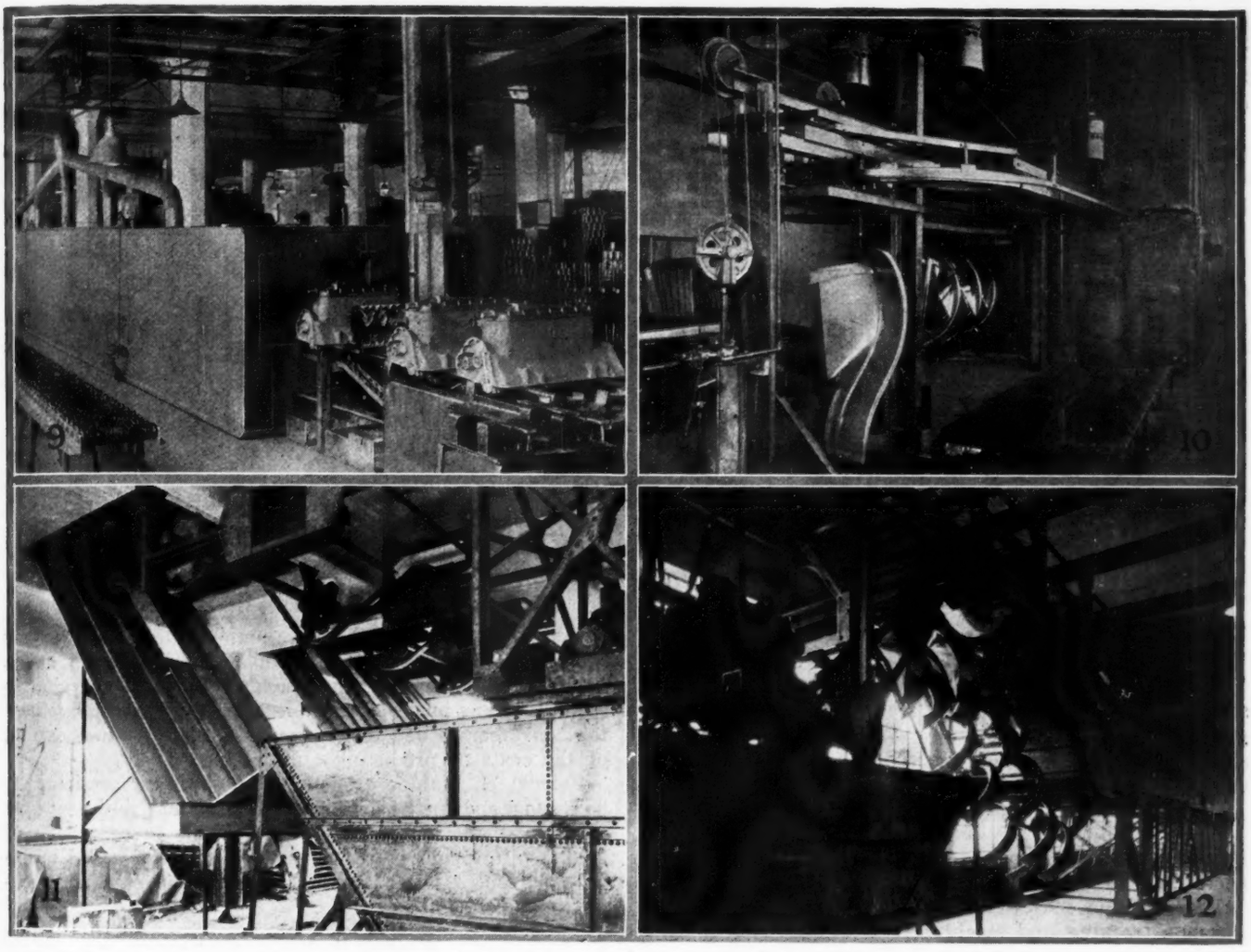


Fig. 9—Continuous conveyor oven installed in the Detroit plant of the Continental Motors Corp. for drying coats of paint on cylinder blocks. Fig. 10—Overhead trolley type japanning oven in the plant of the Federal Motor Truck Co. at Detroit (two ovens side by side used for first and second coats respectively). Fig. 11—Close-up view of dip tank and drain boards of an installation in the Olds Motor Works plant at Lansing, Mich. Fig. 12—Showing dip tank for second coat of installation in Cleveland Automobile Co.'s plant

temperature, which is partly due to the fact that the hot air is discharged into the oven closer to the exit than to the entrance, and partly to the fact that by the time the parts reach here they have acquired a comparatively high temperature themselves and therefore abstract heat from the air at a lower rate.

There has been considerable discussion as to the best form of temperature curve for this type of oven, and the curve shown in Fig. 14 has been published by Drying Systems, Inc., of Chicago, and represents the average of a number of tests on an inclined end oven. It will be noticed the temperature rises about 100 deg. F. higher at the beginning of the decline than at the center of the oven.

With a two-coat oven the second oven is a duplicate of the first. The two are arranged end to end and the same conveyor passes through both but a separate heater is installed under each oven.

Temperature control with these ovens is always automatic, by means of temperature recorders, the indicating hands of which establish an electric contact when they reach either the maximum or the minimum point of the temperature range for which they are set. With the electric heating system it is customary to have one set of heating units in continuous operation and another switched on and off by the temperature control apparatus actuated by the temperature recorder. With the indirect oil or gas heating system substantially the same temperature control apparatus is used, but instead of opening and closing an electric circuit it opens and closes fuel jets or dampers.

When japanning parts it is of the greatest importance that the surface to be coated be absolutely clean and dry, as any moisture on the parts will cause blisters and japan will not adhere firmly to an oily surface. A cleaning or washing process therefore always precedes the dipping and baking process. It is not intended to go here into the details of the cleaners, as that leads into another field, except to say that in some cases the dipping and baking operation is preceded by a burn-off operation in which the parts are raised to a temperature of 650 degrees or more, with a view to burning off all kerosene or oil that may be adhering to them. Drying out of the seams of fenders and similar parts after the washing process involves considerable difficulty, and this is generally done with compressed air jets and with blow pipe flames. A good test of the quality of the japanning consists in putting a piece of sheet metal that has gone through the oven in the punch press. If the japan does not flake or chip at the edges of the punched hole the job is well done.

Parts which show serious defects are rejected. The japan is removed from them by means of a solvent and they are then cleaned and dried and passed through the dip tanks and ovens again.

S·A·E Production Meeting

Human Element in Production Gets Emphasis at S. A. E. Sessions

Speakers at Cleveland center attention on possibilities of developing higher efficiency in shop by strengthening ties between men and management. Tools and plant methods discussed.

EFFICIENT, low-cost production today depends fundamentally on the ability of the management to understand human reactions; to so handle its personnel as to get the best efforts each employee has to give, and to create in as many workers as possible a desire for participation in the problems and achievements of the organization.

Those were the thoughts which, in a broad way, seemed to underlie much of the discussion at the Fourth Annual Production Meeting of the Society of Automotive Engineers, held in Cleveland at the Hotel Winton Sept. 14-16.

The program indicated that only one session—that on foreman training and machinist's training—was to have anything to do directly with the human element in industry. But through almost every session, as the meeting progressed, ran the thread of the human factor as a dominating one, even in the highly specialized operations of modern automotive production.

It came out strongly in the foreman training session where a difference of viewpoint developed as regards the possibility of ever eliminating or decreasing to a minimum the suspicion which often exists between foremen and management. It was emphasized again when K. T. Keller, talking at the production dinner, said that quality, quantity and low cost, the three objectives of production, after all depend upon proper handling of personnel. It came into the picture again at both the machine tool sessions, where the question of safety got considerable attention after the differences of opinion between the machine tool builders and the automotive manufacturers had been thoroughly aired. And the personal predelictions of the purchaser were cited by W. G. Careins as an important factor in influencing machine tool selection.

Several New Developments

But other more specific topics also came in for lengthy discussion and several new developments were brought to light for the first time.

The machine tool sessions brought suggestions from automotive manufacturers that the machine tool industry build less special purpose machines, get into standardization work to a greater extent than in the past and refrain from placing on the buyer as much of the testing costs as often has been necessary. And these same sessions brought from the machine tool builders the contention that the demands of automotive manufacturers are largely responsible for the lack of standardization which exists and the statement that the machine tool men are glad to standardize as much as possible; also that in any business the consumer in one way or another always must pay all of the costs of producing and testing.

Colonel H. Walden announced at the gear session that he is engaged in the development of an entirely new type of gearing and stated his belief that the present basis of gear tooth forms is all wrong. Results of experiments with various kinds of gear steel were reported and commented upon.

Papers of High Quality

The meeting had the smallest attendance and the most consistently high quality of papers and discussion of any production meeting ever held. Attendance at the sessions totaled only about 300, but the discussion in every case was spirited and the number of new ideas developed was large. Viewed from the standpoint of attendance the meeting can not be valued very highly. From the standpoint of worth-while material presented in an interesting manner, however, it was one of the best gatherings the society has had in many years.

Attainment of quality is the prime objective of production, K. T. Keller, general manager, General Motors of Canada, Ltd., told the engineers in his talk following the production dinner on Tuesday evening. Quantity and costs are the two other important elements, he said, but quality must come first. He defined quality as being, not fussy trappings or superficial beauty, but efficient transportation satisfactory to the ultimate owner of the vehicle.

Quality, quantity and low overhead costs after all rest fundamentally on a proper handling of personnel, Mr. Keller pointed out, urging that the workmen in each plant be given a fair opportunity to do their jobs right. The idea of quality, he said, must be thoroughly soaked into the entire organization from the top down.

Quantity production demands an organization capable of looking ahead, Mr. Keller continued. Such planning as regards machine tool requirements and operations is common, he pointed out, and relatively easy. The trouble comes, he said, when some man suddenly conceives a new idea at a time when tool changes are needed. The new idea may necessitate long consultations with machine tool

K. T. Keller

Quality is the prime objective of production, said Mr. Keller; general manager, General Motors of Canada, Ltd., who spoke at the dinner Tuesday evening

builders, getting of an appropriation for new machinery, waiting for the preparation and installation of special tools and a period of experimental operation in actual production. Ideas of this kind, in Mr. Keller's opinion, have been responsible for more production delays than any other single factor.

To inhibit such ideas, he pointed out, is wrong, but to try to utilize them at the wrong time is inefficient. The sensible thing to do is to encourage them and to use them when plenty of time is available for carrying them out without interruption to the regular production program.

Planning is the most important factor in quantity production, he said, adding that nobody yet really knows what can be gotten from an assembly line because the rate of assembly depends altogether on the way in which parts are supplied to the line.

Mr. Keller urged that the percentage method of figuring overhead costs be considered as meaning little. He advocated that the general manager observe and study carefully, individual workers in the plant and office organization, asking the question in each case, "Just what function does he perform for the money that is paid to him?" Through this individual method of studying costs, he said, overhead really can be reduced. The chief efforts in cost reduction, he stated, should be made in the non-productive departments, such as purchasing, accounting, etc.

An Undeveloped Field

Summarizing his discussion of costs, Mr. Keller pointed to this phase of production analysis as a very large, undeveloped field in which considerable progress should be made in the future.

Referring to the rather rapid change in the personnel of some automobile factories, Mr. Keller voiced the opinion that production men may well change from one job to another in the early years of their work, so long as they are sure that the change is being made for the sake of greater and broader experience in their chosen work.

He said that a factory should not keep a man in its organization for a long while unless the management is satisfied that the man has a chance for constant future development. It isn't fair, Mr. Keller believes, to hold on to a man when the management is reasonably sure that he isn't going to make any further progress.

Promotion of men from within the plant brings far better production results, in Mr. Keller's opinion, than does the practice of bringing in men from the outside to fill vacancies which occur from time to time. In line with a policy of providing for future executive needs within the organization, Mr. Keller said that his company is taking six young men every year and starting them through a course of training covering every phase of the business. At the end of the year six more men are taken on and those of the previous year's group who have shown no aptitude or liking for the work are let out. In this way a reserve for future needs is being built up.

Automotive and Machine Men Air Differences

Machine Tool Session brings two groups together in conflict but discussion develops mutual understanding

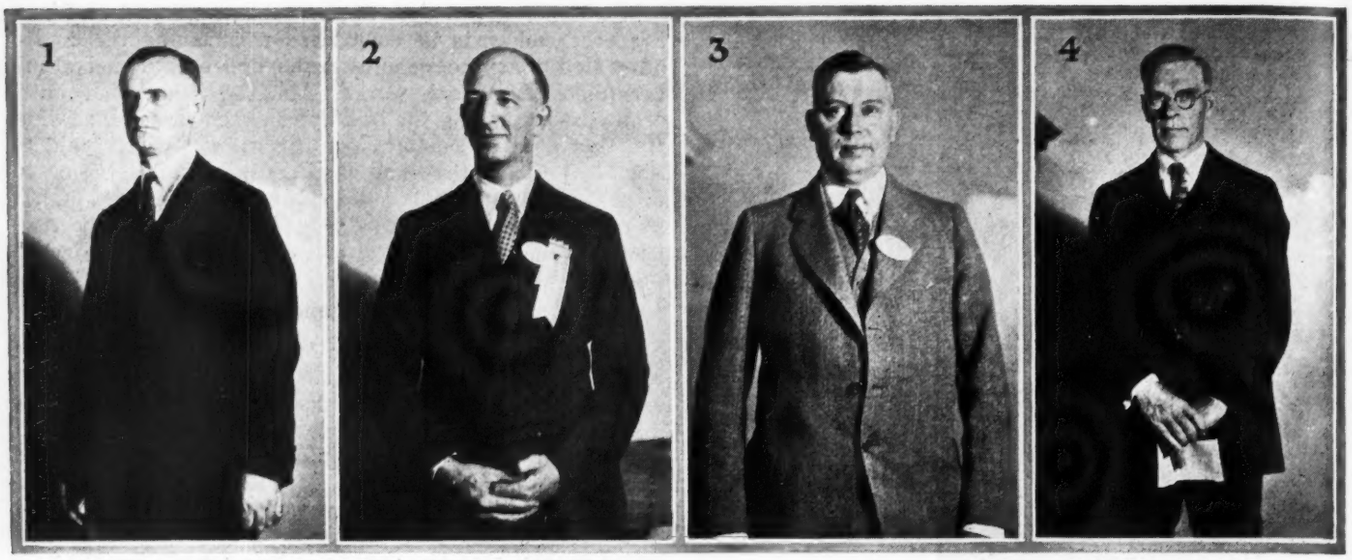
By W. L. Carver

THE machine tool session of Tuesday afternoon proved to be a crossroads meeting between the production men of the automotive industry and machine tool builders, and, as is the case with all crossroads, some confliction of traffic arose.

For awhile it seemed that the pot was calling the kettle black, but discussion developed mutual understanding and appreciation of the fact that each of the two industries is in business to make a profit and that, while exceptions to good business practice and ethics exist in both industries, these are by no means the rule. The net result was as lively a session as has been held at any recent S. A. E. meeting. Although the attendance was not great, interest and discussion measured favorably with some of the four-wheel brake and balloon tire sessions of a year or so ago. Eugene Bouton of the Chandler Motor Car Co. presided and made a considerable impression with his statement that salesmen for the machine tool builders should know something about their machines and that the automotive production man is heartily sick of the golf stick type of machine tool representation.

Discussion centered largely around the paper, "Machine Tool Needs of the Automotive Industry," presented by R. M. Hidey, works manager of the White Motor Co. In this paper the apparent concentration of the machine tool industry on single purpose tools with incidental neglect of the standardized machines, the lack of cooperative effort within the machine tool industry and the lack of standardization were advanced as shortcomings which, in the opinion of the author, were hampering automotive production progress.

Refutation of the opinions advanced was not slow in



R. M. Hidey (1), *White Motor Co., suggested how the machine tool builders might improve their service to automotive manufacturers*

Eugene Bouton (2), *Chandler Motor Car Co., presided at the first machine tool session and urged that machine tool salesmen get a more complete knowledge of the product which they are selling*

W. G. Careins (3), *Ajax Motors Co., outlined principles of machine tool selection*

R. M. Anderson (4), *Holley Carbureter Co., talked on drill press applications*

coming from the machine tool side of the house, and Mr. Hidey averred at the end of the discussion that it was his purpose to stir up something which might benefit both industries.

A. C. Cook, vice-president of the Warner & Swasey Co., stated that the general trend of the machine tool industry at this time is in the direction of standard machines which can be equipped with special tooling to meet the requirements of specialized jobs, thus making them multi-purpose machines. He emphasized the fundamental difference between the machine tool and automotive industries, this being that the former sells to a trained expert market, whereas the latter sells to meet general popular demand. Further, he continued, his experience indicates that machine tool builders are not backward in exchanging information and visiting shops of their industry, but that the problems of the various forms of machines are widely separated and not amenable to the same degree of standardization which is characteristic of the automotive industry. Also, safety appliances are an admitted problem and are aggravated by the great variety of safety codes which exist in the 48 States of this country.

Economic Demand Governs

Economic demand rather than the machine tool builders' wishes determine the type of machines which will receive attention at machine tool plants, and the reasons for special machines are just as sound as those for the standard machine. This statement was made by E. F. DuBrul of the National Association of Machine Tool Builders. Also he insisted that Mr. Hidey had drawn conclusions from the exceptions of machine tool builders' practice instead of from the general trend and that, furthermore, he knew of no industry in which the cost of engineering, testing, etc., was not borne by the customer. Further, Mr. DuBrul said that his quotation which was incorporated in the paper was not made in its original sense, his thought being that industry as a whole is not expanding rapidly and therefore the machine tool builder must find his business and profits in the sale of equipment which will replace that which is worn out or obsolete in existing plants by newer designs which render greater service. As to safety appliances, such as belt guards, etc., the variety and confliction of laws and the fact that these laws are not coordinated or even gathered together necessitate throwing this work on the purchaser.

Oftentimes the ignorance of the buyer and his insistence on certain types of machine complicate the relationship of the builder and user. Mr. DuBrul insisted that standardization is needed, but in his opinion the pressure which will bring this about will have to come from coordinated action by machine tool buyers because many small builders will produce anything that the buyer demands under present conditions. In the end the machine tool industry will conform to the demands made upon it by the automotive or any other of the industrial buyers and users.

Various automotive men in the meeting emphasized the fact that standardization in the automotive industry began internally and never would have come about if the customers' demands had been awaited. In reply, the aggregate answer of the machine tool builders was emphasis on the fundamental distinctions in the two industries and their customers, although Mr. DuBrul inferred that many of the machine tool builders feel that they lack funds for attempting any comprehensive coordinated action. Among those participating in discussion along these lines were Joseph Lannen, John Younger, Anthony Scaife, W. W. Nichols and others.

In the second paper of the afternoon W. G. Careins of the Ajax Motors Co. discussed "Machine Tool Selection," beginning by dividing production equipment into three classes, as follows:

1. Job shop work in which there is practically no duplication.
2. Semi-production shops in which there is an appreciable duplication of processes.
3. The manufacturing plant engaged in extensive production of standardized parts.

These, with the possibilities of expansion, are the primary factors in the selection of types of equipment.

In planning new equipment, the following elements should be scrutinized carefully:

1. The characteristics of production.
2. The methods used generally in the shop.
3. The design of the product and the possibility of early changes, as in the case of manifolds and brake linkage.
4. Production costs including labor, overhead, depreciation, etc. For special machines the latter should be placed at twice the value of that for standard machines and the estimate for maintenance should be raised accordingly.
5. Delivery, particularly for special machines, where at least three months is a safe allowance.
6. The cost of the machine and the required incidental equipment.

Careful selection of the builder should follow, based on his location, reputation for service ability, etc. Both the builder and buyer should cooperate throughout the entire transaction by complete exchange of information. Many machine tool builders do not submit comprehensive proposals and their absence leaves an element of grave doubt in the minds of buyers. Here Mr. Careins criticized the tipster methods of machine tool salesmen who inundate the prospective buyer's plant on the vaguest assumptions.

Upon receipt of bids and specifications, the choice should be based on cost, production ability and the ability of the machine to stand up to the specified service. Where land values are high, the required floor space may be an important factor. Many machines are mechanically good but their clumsy controls rule them out. Also appearance is an asset not to be overlooked.

Weak Points Pointed Out

Mr. Careins also pointed out a number of weak points in present machine tool practice which are not universal but do crop up with undue repetition. These are listed as follows:

1. Poor countershafts are shipped with excellent machines.
2. Motor mountings look like afterthoughts.
3. Drive belts are too narrow for any but ideal conditions.
4. Pumps require priming too frequently and often lack sufficient capacity for the lower ranges of the machine's speed.
5. Cast iron gears, cams and levers are out of place in the modern production machine.
6. Oil cups, oil holes, where there are twenty or more, are a nuisance and will not be filled every hour or so. These should be replaced by a central reservoir system.
7. The inaccessibility of working parts renders repairs and adjustments too expensive.
8. Guards are inadequate and poorly planned.

In the concluding paper of the afternoon R. M. Anderson of the Holley Carburetor Co. discussed "Drill Press Applications" as related to the production of Ford and Fordson carbureters. In one battery, 37 drill press heads of varying sizes are lined up to match with the fixtures which are bolted on a long cast iron table. With this arrangement, in conjunction with carefully selected tool equipment and sequence of operations, 20 men can produce about 2500 carbureter bodies per day. The drill press type of equipment was chosen for its simplicity and the ease of repair and replacement. Furthermore, the combination of the equipment and its arrangement supplies the opportunity for varying production schedules at short notice. This was an important factor in the consideration of this equipment, as the company anticipated summary increases in production schedules.

More Multi-Purpose Machine Tools Are Needed

R. M. HIDEY of the White Motor Co. gave the machine tool needs of the automotive industry as being multi-purpose machines capable of using special equipment, factory design and installation of safety devices, better balancing of moving parts and more cooperation, not only between machine-tool builders and automotive manufacturers, but among the machine tool manufacturers themselves. His paper, in part, follows:

A question which is causing considerable concern to many equipment engineers is the advisability of using single or multi-purpose machines. There has been too much attention paid by the machine-tool industry to single-purpose machines, which satisfy the demands of only those concerned with large production of a limited line.

There is, however, a real demand in the automotive industry for multi-purpose machines, as, with frequently varying production demands, it is at times decidedly advantageous to be able easily to change jobs from one machine to another, to another department or even to another plant. Standardized machines fitted with special tools for the performance of a variety of jobs should be cheaper to build and operate, and would be a source of profit to the machine-tool builders and to the automotive manufacturer.

The failure of machine-tool builders adequately to equip machines with safety guards increases installation costs to a distinctly unnecessary and uneconomical extent. It is necessary for us to spend from $20 to $75 in order to make new machines safe for our men to operate. The builders of machines should be able to equip their machines more satisfactorily and cheaply with safety guards than the customer, as a standardized practice could be followed for their individual product. The net result would be that all machines would be properly guarded and with a decided economic saving.

There has been considerably more cooperation between machine-tool builders and their customers than there has been between the machine-tool builders themselves.

Manufacturers in the automotive field freely give information to competitors as well as others and permit full access to their factories with the exception of their research and experimental departments. This cooperative spirit does not exist in the machine-tool industry. However much they have cooperated with the automotive industry, they themselves have not gotten together with a comparable spirit for the working out of mutual problems. The desire to excel has predominated to the exclusion of the cooperative spirit, which would have resulted in stabilizing the machine-tool industry.

Millions Spent Yearly

The automotive industry spends millions yearly in designing and experimenting, while the machine-tool industry is not spending a proportional amount on developments of machine tools. Instead of actively pioneering, often builders are content with simply replacement orders for machines which have worn out. No less an authority than Ernest F. DeBrul, general manager of the Machine Tool Builders Association, points out that production of machine tools being at a normal rate, but with no appreciable rate of expansion, "the machine tool industry depends rather upon replacement business than on new industrial developments." This statement indicates clearly the attitude of the industry—it stands waiting to take

orders. It is not actively pioneering new fields—new and better methods.

Especially has testing, a burden which should properly be borne by the builder, been thrown upon the buyer. Generally the builder calculates a certain performance of a machine which he places upon the market; and, after the machine is delivered, from a few days to several months is spent in trying to secure that performance.

If the machine-tool builder would analyze his buying public and their needs, he would have much less to rectify after the machines were on the market. Production of today demands working to very close limits, and, when we speak of close limits, we, at the White Motor Company, do not mean in thousandths, we mean in ten thousandths. A thorough analysis of the needs of the automotive industry will give the machine-tool builder greater and more stable profits, and will increase his service to the user.

The automotive manufacturers would be pleased to see standardization worked out for such features as spindle noses, internal and external turret holes, lead screws, working heights and standard machine data sheets. These are not salient features of a machine and would not jeopardize its sale; yet a manufacturer who has a large diversity of machines of similar make would be able to reduce his cost appreciably, if such features were standardized.

The balancing of moving parts has been almost entirely neglected by machine-tool builders. The vibration of moving parts such as gears, wheels, and shafts, which are seldom balanced, is frequently excessive and materially decreases the life of the machine. This improvement could well supplement the other standardization which we have recommended.

In summarizing what the automotive industry needs in the way of machine tools, we desire to make the following specific recommendations to the machine-tool builders:

Develop multi-purpose machines capable of using special tool equipment adapted for quick change-overs.

Safeguard all machines, so that they can be put into immediate operation without extra expense to the customer.

Balance all moving parts properly so that vibration will be reduced to a minimum.

Continue cooperating with the automotive industry. Furthermore, actively cooperate with each other, as the free interchange of new ideas and developments would be of infinite value to industry as a whole.

Study the demands of your market, analyze the needs of the automotive industry, not only for today, but for the future as well, so that your dependence on replacement orders may give way to active production for analyzed needs.

Debate Arises On Who Should Train Foremen

Foreman training session discusses use of outside agencies or plant men for conducting educational programs.

By Norman G. Shidle

FOREMAN training always should be conducted under the supervision of some executive within the plant and should have the whole-hearted support and active assistance of the chief executive if it is to be successful. Outside speakers may well be brought in to talk to foreman groups, but to turn over responsibility for and the work of foreman training to any outsider is pernicious.

This point of view expressed by Louis Ruthenburg, general manager, Yellow Sleeve Valve Engine Works, in his paper on "Training Shop Foremen" and backed up by L. W. Wallace, executive secretary, American Engineering Council, and by a number of other participants in discussion, was disputed by F. T. Jones, supervisor of training, White Motor Co., who talked on "Products and By-Products of Foreman Conferences." Mr. Jones' view got some support, while others were inclined to believe that conditions within particular organizations should be the determining factor.

Mr. Jones based his favor of outside men to handle foreman training chiefly on the ground that foremen, who usually are former workmen, tend to be suspicious of anything started or told to them by the management. An outsider coming in, he believes, is free from that suspicion and therefore can do better work.

Wallace Supports Ruthenberg

Opposing this idea and supporting Mr. Ruthenburg's contention, Mr. Wallace pointed out that if a company cannot get the confidence of its foremen, there is something more fundamentally wrong in that plant than mere lack of foreman training. Efficient production operation is not possible, other proponents of this idea pointed out, unless such atmosphere of suspicion be broken down in every way possible. Where such suspicion does exist, moreover, it was contended, it is hardly likely that the foremen would accept as unbiased any outside agency brought in by the management. If they don't believe in the management they aren't very likely to believe in the agents of the management.

Mr. Jones contended that any manager who thinks he has the confidence of his foremen and workers had better watch out, because he probably hasn't. Asked by Mr. Ruthenburg whether or not he believed it possible to remove an attitude of suspicion among foremen, Mr. Jones replied that "It might be possible, but that it isn't practicable because it would be contrary to human nature."

It was generally agreed by all present that foreman training today is essential to proper functioning of the production department, but it was emphasized that the spirit and ideals behind the training have to be carefully laid down if work of this kind is to be at all successful.

Mr. Jones stated definitely his belief that foreman training is necessary. The time has passed, he said when there can be any ifs about it. In this he was supported by the other speakers, Mr. Ruthenburg and Mrs. Lillian M. Gilbreth, as well as by those who discussed the question informally.

Mrs. Gilbreth, Gilbreth, Inc., talked on the training of "Employees in Production Work" and showed how training is being carried on in every factory whether it is consciously organized or not. She discussed the rela-

They hold opposing views on foreman training

Louis Ruthenburg, general manager, Yellow Sleeve Valve Engine Co., who urged that more attention be given to the spirit and less to the form in foreman training. He believes that such training should be conducted by some executive representing the management

Franklin T. Jones, supervisor of training, White Motor Co., contends that the natural suspicion of the foreman for the management makes it advisable to have foreman training handled by some outside agency which the foreman may regard as unbiased

tive merits of the training school kept separate from the factory proper and of training carried on in the regular production lines. In the former type, she said, it is possible to reproduce all production conditions except that of incentives; that factor is an important one. A digest of Mrs. Gilbreth's paper appears on later pages.

Despite the efforts of peacemakers in the discussion, examination of the papers by Mr. Jones and Mr. Ruthenburg seems to show a difference based, to some extent at least, on fundamental conceptions of human actions and reactions as well as on disagreement concerning some of the more superficial phases of foreman training development.

Mr. Ruthenburg laid emphasis on the absolute necessity of having the spirit behind the foreman training right. He believes that a long time should be spent if necessary to build up a background of confidence among the foremen before training is attempted. Without that confidence as a background, Mr. Ruthenburg thinks, foreman training is likely to be of very little value. Too much attention in the past has been given to the form and not enough to the spirit of foreman training, in his opinion.

Mr. Jones' statements indicate his belief that it is possible to save the long period of preparation for training, which Mr. Ruthenburg admits may be necessary, by bringing in some outside agency, such as the Smith-Hughes men, with the idea that the foremen will accept them as an unbiased agency, even though they are working very closely with the management.

A close examination of the following digests of these papers will give further indications of the basic difference between the two approaches to the problem.

Foreman Training Essential in Functionalized Industries

INDUSTRY during the past decade has been going in heavily for specialization of management functions so that the department foreman's old job has been divided among several men and departments. The foreman is still needed as the responsible head of the department, but Louis Ruthenburg, of the Yellow Sleeve-Valve Engine Works, believes he must be trained to know the full value of functionalization.

"Industrial development has run away from foreman development," Mr. Ruthenburg said, "and the foremen see in the various special services a ready made alibi for themselves instead of a valuable addition to operating mechanisms. Training, conducted along broad economic lines by men whose own experience and training command the respect of the foremen, is given as the way out of the labyrinth wherein many present day foremen become figureheads of little value to their organizations.

Permanence and Profits

Mr. Ruthenburg's paper was, in part, as follows:

The major objectives of a manufacturing organization are usually permanence and profits. Given a salable product, a competent selling organization and sufficient financial strength, permanence and profits depend upon the high quality and low cost of the product, as compared with the quality and cost of competitive products.

Good foremanship is a most important factor in establishing and maintaining high quality and low cost.

The complexity of manufacturing organization has increased at a prodigious rate and, while we have been adding many fine, theoretically effective specialized functions, our shop foremen have been given mighty little real training and information.

Industrial development has run away from foreman development.

Isn't it a fairly sane idea to tell these foremen what "all the shootin's about" and, incidentally, to once more hold them fully responsible for the operation of their departments?

It is highly desirable that we retain the great advantages of functionalized plant control. But in order to reap the full benefit of the system, we must eliminate "buck-passing" and reduce overhead charges to a minimum. I know of no method of attaining these objectives, which is as direct, inexpensive and constructive as that of properly training departmental foremen.

If we start with the assumption that the foreman is to be held fully responsible for every activity that affects the operation of his department, we are immediately confronted by the fact that he cannot be given direct authority over certain functionalized services which very directly affect the operation of his department.

He must, therefore, develop that higher type of executive ability which can obtain results without the club of direct authority. He must understand the reasons for and the methods of operation of these functions. He must learn the arts of persuasion, sound salesmanship and diplomacy.

Business management, even of a factory department, involves an understanding of many things which the foreman cannot learn thoroughly or systematically in his craftsmanship experience. Business problems usually resolve themselves into one or more of three elements, which may be briefly tabulated as follows:

1. Technical elements—the "know how"—the practical phase.
2. Economic elements—the "dollars and cents" relationship—the "will it pay" phase.
3. Human elements — salesmanship in its broader aspects—the "getting cooperation" phase.

Foremen, by virtue of their craftsmanship training, are usually most proficient in the first element of business management, above tabulated. They are quite generally deficient in the second and the third elements.

Wrong Ideas of His Duties

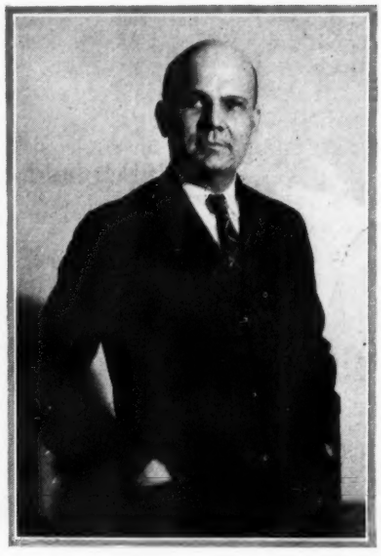
I sometimes think that we have fallen into the very general error of assuming that a foreman's duties are simply a logical extension of the craftsman's duties. Certainly the average foreman has had no systematic or intensive instruction in any science or art other than those relating to his craft. The average foreman is simply a skilled craftsman, naturally endowed with a little more intelligence or ambition or "guts" than his fellow workmen —all essential characteristics in a foreman. But without systematic training, his knowledge of industrial tradition and principle; of simple economic values; of the art of dealing with men in positions subordinate, coordinate or superior to his own, must necessarily be accidental, instinctive or non-existent.

I know there have been many attempts at foreman training which have either failed or produced indifferent results. These failures prove little except that wrong methods were employed. We can't force knowledge into a man's being. Education is a "leading out" process—not a "forcing in" operation. And many attempts at foreman training have failed because this elementary principle has been disregarded.

Until an attitude of enthusiastic receptiveness exists or has been created among the men to be trained, attempts at training will produce disappointing results.

Then it must be remembered that the best training results can only be expected under able leadership and strong personal inspiration. It should be generally recognized among the foremen that the general superintendent or the works manager or the vice-president in charge of production, or even the general manager or the president himself, are enthusiastically interested and believe firmly in the project. Although the routine work must be delegated in large part to an able subordinate, this subordinate must have the boss's enthusiastic support and help. And be sure that the company official who gives this matter his attention is a practical manufacturing man. In this particular matter, your foremen are usually, and for obvious reasons, uncertain of leadership of other types.

Then be sure that your routine lecturer is a *teacher*. He must command respect for his knowledge and ability.



L. W. Wallace, executive secretary, American Engineering Council, who supported Mr. Ruthenburg's views on foreman training

He must be able to explain abstract principles by concrete illustration. He must know your organization methods intimately. Other able speakers on special subjects should be enlisted to relieve him from time to time.

Enlisting the enthusiastic interest of the foremen, strong leadership, able teaching personnel are all of primary importance. Initially, at least, method is more important than text matter. *How* takes precedence over *what*.

In selecting or preparing text material and lectures, it should always be kept distinctly in mind that while we are endeavoring to teach *principles*, an average mind thinks in concrete terms and, therefore, finds it difficult to absorb abstract ideas. Consequently, every principle or abstract thought presented must be immediately and as graphically as possible illustrated by some concrete practice or parallel with which all the men in the class are familiar.

Let your text matter present definite information as interestingly as possible. Inspirational preachment should be injected sparingly, if at all. It is probably safer to depend upon a verbal spell-binder if such spiritual food is considered indispensable.

When training is soundly started with any group, it has a tendency to be self-perpetuating in interesting and constructive developments. To cite only two examples with which I am intimately familiar. Foremen and superintendents at the Delco plant in Dayton have continued their classes with great enthusiasm and profit for five years, advancing each year to new and interesting studies of industrial subjects. And a class of less than one hundred foremen from diversified industries which met in the Dayton Y. M. C. A. five years ago has evolved into the Ohio Federation of Foremen's Clubs, a wonderfully fine organization of over 3000 men.

Hiring and Firing Expensive

It costs a great deal of money to hire and fire foremen. The fact that careful training greatly reduces foreman turnover has been very completely demonstrated.

Most of us are willing to admit that we have a sort of God-given intuition that permits us to choose good men for responsible positions. Some men, undoubtedly, do have a natural gift or a cultivated ability for sizing up capabilities in other men with uncanny accuracy. But with most of us, our pride in ability to pick winners is the result of remembering our successes and forgetting our failures. When we try to set down definite reasons for thinking a man will be a winner or a dud in a future

Mrs. Lillian M. Gilbreth, Frank Gilbreth Co., Inc., discussed methods of training employees for production work

position, we often find that our opinions and prejudices are not entirely dependable.

Most of us buy pig iron or steel or fuel to definite specifications subject to analysis by our own laboratories. Isn't it at least equally important to select and promote men under "specifications" as nearly exact as it is possible to define them and subject to analysis as accurate as the undeveloped state of the art permits?

The importance of good foremanship as a means of reducing cost and of increasing quality must be obvious. It is apparent that traditional methods of foreman training are inadequate when the complexity of present industrial organization is taken into account. If the departmental foreman is to assume a position of maximum value under modern conditions, the problem of training present and future foremen must receive careful study and the economic and human elements of his job must not be neglected. Enough has been accomplished to demonstrate the feasibility and value of such training.

Studying the Major Problems in Employee Training

VISUALIZATION of the problem, method of attack and transference of skill are main entries under "What to teach employees," as stated by Mrs. Lillian M. Gilbreth. "Who" may be a teacher trained in production or a worker trained in teaching with the latter type preferred. "When" is not so important but should include in duration the period of employment. "Where" includes both the laboratory and the shop. "How"—by all possible means. The answer to "Why" is given as "Education lies at the base of industrial progress. Without education progress can seldom be permanent and never be cumulative." Mrs. Gilbreth said, in part:

There is perhaps no better way of grouping the various topics that should be taken up by teaching than under the old headings WHAT should be taught, WHO is to teach it, WHEN is it to be taught, WHERE is it to be taught, HOW is it to be taught, and, finally, WHY is it to be so taught?

The first necessity in presenting WHAT is to be taught is to visualize the problem. The teacher and the student must be able to understand and to agree upon what industry is as a whole, what the particular plant in which the work is being done stands for and is doing; the work of the department; the operations performed in it; the processes under each operation, and finally the cycles of motions and the elements of these cycles that constitute the work of the specific employee himself.

A second thing that is to be taught is the method of attack. In order to increase production one must

a. Eliminate motions and fatigue,
b. Simplify existing methods, by analyzing them into elements and then adding together the best and shortest elements, to form the new work process.
c. Standardize, that is crystallize the findings into such devices as simultaneous motion cycle charts and instruction sheets.
d. Maintain, through standing orders, change orders, the suggestion system, adequate records and programs and such charts as the statistical department furnishes.

The elimination of motions and fatigue can be done partly through a survey. Even the most inexperienced of learners will be able to cut out unnecessary activity and the consequent fatigue by making a close study *in writing* of what he actually does, and why. The written survey can, of course, be supplemented by photographs and better still by micromotion films which record what is actually happening, with a clock in the record supplying the time element, and preferably also a cross sectioned background, which aids in locating any specific point to which attention is directed.

Process of Simplification

The process of simplification demands first of all records of best existing practice, then selecting from these records the most efficient elements and combining these into a new one best way of doing the work. The one best way, considering the available worker, surroundings, equipment and tools, is transferred to the instruction sheet, which becomes the manual and text book for the learner not only as to *what* is to be done and *how* it is to be handled, but with the results required, both in time and output.

Perhaps the most important element to be emphasized in learning a new method is that of maintenance. This is provided for through the instruction card and the standing order, which contains the various factors as already listed under the teaching process, namely, *what, who, where, when, etc.* The change order supplies the mechanism for change. The suggestion system supplies a vehicle for bringing desirable changes to the attention of those in authority, and adequate records furnish not only bases for efficient judgment on the value of what is being done, but satisfactory data for making programs and predicting trends of development.

A third thing that should be taught is the importance of the transference of skill. The transference of skill depends upon likeness if not identity between the thing already known and the thing to be learned. The recent developments in motion study consist of analyzing motions into therbligs and comparing these therbligs, in order to establish underlying laws of efficiency in their performance.

If we list them without attempting to add any background or description, we shall illustrate this. 1, search; 2, find; 3, select; 4, grasp; 5, transport loaded; 6, position; 7, assemble; 8, use; 9, disassemble; 10, inspect; 11, proposition for next operation; 12, release load; 13, transport empty; 14, rest for overcoming fatigue; 15, other periods of unavoidable delay; 16, avoidable delay; 17, plan.

Through these therbligs, skill is transferred, and by

the relativity of simultaneity of the various parts of the body as they perform the various activities indicated in the therbligs, is the amount of skill estimated.

The teaching may profitably come from many sources. The teacher may be an efficient worker, who demonstrates his work methods to the learner. This method is especially effective because of the kinship between pupil and teacher and because the learner can see the value of the methods taught in the records of successful production of the teacher himself.

The teacher may be the foreman, and if so will succeed best if he has been taught not only the one best method, but how it should be transferred and if he is made to share, in some very definite and direct way, in the success of the worker or learner. He can only be really successful if he has been trained in teaching, if he has a knowledge of the one best way, and why it is the one best way, and if he is convinced of the necessity of there being one best way taught.

Inspectors as Trainers

A certain amount of training may profitably be done by the inspector, who, at least, in scientifically managed plants, stays with the worker always while he makes the first piece of a new lot, notes both successes and failures and supplies the necessary instruction.

Today in many organizations the greater part of the teaching is in the hands of a training department. There is constant argument as to whether the members of this department should be trained teachers, who have acquired the technique of the special plant in which they work, or, members of the organization, well versed in plant operations, who have acquired more or less knowledge of how to teach either at school or college or by other study. We have found most success with the latter type, selecting the best available material of the organization itself, and adding such instruction in the theory and practice of modern psychology and education as is necessary.

If the training department undertakes the teaching, it should furnish not only preliminary training, but training at the work place itself, and follow up and maintenance, as these are necessary.

The work of teaching in an organization should not be confined too strictly to any one time. A certain amount may profitably be done when the new employee is being hired. He should learn at that time much more about the organization, its work and especially the opportunities in it for him than is usually the case.

The proper organizing and operating of a training department is becoming rapidly standard practice—and this is one of the greatest advances in employee training to be recorded.

No training is adequate that does not accompany the learner from the training period or class room work into the work place itself. Laboratory conditions can never parallel working conditions, and the place of the teacher is with the learner at the work bench until the good habits of the training department have become firmly established in the work place itself.

Supplementary teaching may well take place either in the class room or laboratory or at the work place. But here, as in the preliminary teaching, the teacher must finally accompany the learner back to the work place to make sure that the new habits are firmly established.

The newer method also must be completely "sold" to the learner. He must have absolute confidence not only in the method but in his ability to use it and he must see with his own eyes the increase in production or the decrease in effort and fatigue. He must actually himself MAKE MORE before he can be considered completely taught. He must be able to do the thing, must actually do the thing continuously successfully, and must want to do it before he has actually learned to do it, in the right sense of the term.

Perhaps the greatest failure in present day teaching in industry is the lack of follow up. Any organization which has a training department can profitably make a periodic survey, comparing the methods as taught, the methods actually in use and the methods as approved by the workers and supervisors. It will be the exceptional industry where no discrepancies occur!

Supplementary Instruction

Besides such training as he receives in classes, every employee can profitably receive other supplementary teaching through meetings of different kinds, sometimes of workers engaged in similar work, sometimes of workers and foremen, sometimes of workers who are doing similar work in other shops or industries, often at technical meetings where efficient production methods are discussed.

We have mentioned that some teaching can profitably take place in the laboratory or department of training, and that some must be done at the work place itself. There are distinct advantages to bringing the employee at certain times into the laboratory or training department. Nothing will convince him of the value of the methods that are being taught as much as seeing the research data upon which they are based. If he can once actually see how the standard method is derived, he will look upon all standardized methods differently, always.

It will surprise anyone who has not had experience in this work to see how the process chart, the micromotion film, the simo chart and the illustrated instruction card are followed easily and with the most intense interest by a worker who knows the work process intimately, even though he has no knowledge of the technique of making and using the records.

It is perhaps not inappropriate to speak a word here of training of teachers, as it is perhaps the greatest and most pressing need at present in the training of employees in industry. All teachers should not only go through a period of being actually workers, but should periodically return to the status of workers and a first hand realization of the working condition existing at the time, and of what the teaching can be expected to do. By this means also they will become acquainted with one of the greatest needs in teaching, and that is provision for change and improvement in methods. Working conditions and equipment constantly become better, and so often do the type of workers assigned to the work. All of these furnish a demand for a reconstructed better method. The one best way, is only the one best way while the worker, surroundings, equipment, and tools remain the same. It should be the function of the teacher to note the improvements in the various factors of the work, and to see that the method is improved to meet the changing conditions, and is taught and maintained in its most recent form.

Methods of Teaching

There is but one universal rule that covers this, namely, that teaching should be done by all possible known means. First, perhaps, and most important, through the eye, by means of manuals or text books or any other type of instructions. These to be supplemented by the visualizing devices that have already been mentioned, especially by process charts, micromotion films, cyclographs and anything else that will enable the learner to see *with his eyes* what he is expected to do. Second, through the ears, by lectures and informal talks, both by the regular teachers and by successful workers. Third, by an appeal to the motor sense, by the use of motion models that enable the worker actually to follow with his hands the path of the

motion that is recommended as the one best way. There is nothing more important than actually DOING the thing taught, in order to understand its difficulties and the methods which overcome them.

A general survey of the availability of the different senses for inspection work should be made. In a certain operation in folding handkerchiefs an extra motion was detected by the ears, which the eyes could not detect because of the speed with which the work was done, and every driver of an automobile knows the efficiency of hearing in inspection.

Touch, taste, smell, all are available and have been proved useful.

We have already spoken of the importance of the transference of skill. Education lies at the base of industrial progress. Without education progress can seldom be permanent and never be cumulative.

Reason Must Go with Rule

The reason must go with the rule. Theory must underlie successful teaching. Psychology, physiology, psychiatry, economics engineering, education, all are essential. This may seem at first glance a broad statement, yet anyone who has tried to answer questions of a worker as to why methods have been changed will know that all of his knowledge and sources of information in these fields may prove inadequate.

Education in its best and finest sense consists of two things, first, research, and second, transfer, and neither of these can be neglected in the industrial field. Education in industry, in any scientific way, is a new thing. The problems of teaching in industry are even more complicated than are the problems in the colleges and schools. There is a call for the best knowledge of transfer, for the most complete research in this field.

We have in industry those who have learned little; those who have learned much; those who are learning constantly; those who have stopped learning. We have eye people and ear people and motor people, people of fixed habits and people whose habits have never become so established as to be an asset. An infinite variety of learners, an infinite variety of things to be learned, and a learning process with fixed underlying laws that must be applied to each individual need.

Big Strides Being Made

This all sounds very complicated and perhaps rather hopeless, yet the greatest strides in education today are undoubtedly taking place in the industrial field. In the past we have listed the contributions of education to industry. In the future we shall be listing the contributions of industry to education. New development in motion study, fatigue study and skill study, new interest in the applications of psychology and psychiatry have come largely in the industrial field. Scientific management itself is an industrial development, and scientific management is applicable to education, also an appreciation of the need of teaching in industry is increasingly evident, not only in the literature and in the programs of the various meetings, technical and other, but in the industrial plants of the country. Training departments are supplementing the work of planning departments, courses for executives, for foremen, and for workers are increasing in numbers and in extent. It seems important at the present time to make a survey of all that exists, to evaluate it, to discard what is unessential, or of little use, and to make sure that the development is along lines of maximum efficiency. Where efficient research and transfer work is done, the value of teaching can demonstrate itself in increased production.

F. T. Jones Gives His Theories of Foreman Training

F. T. JONES summed up his discussion of foreman training by urging consideration of the following:

1. Discussion of foreman training should be no longer on the basis of "whether" but on the basis of "how."
2. Men to do the training should be selected with great care.
3. The course must be planned effectively on the basis of past experience.
4. Results that reasonably may be expected should be outlined and carefully checked up.
5. Small successes and slight advances should be accepted as satisfactory in the early stages of the work. An attempt to achieve very large results with all of the men in the plant at the same time is likely to meet with failure.
6. Continuity of effort is essential.

The work at the White Co., he pointed out, has brought about a large number of very real results, both direct and indirect. Among these are better understanding between management and men, better cooperation between various foremen and departments, better knowledge of the job by the foreman, increase in departmental efficiency, and a number of others.

New Rating System

He discussed in detail also a new method of rating foreman efficiency which he has worked out himself and has found successful in its two years of operation. Mr. Jones said in part:

The State departments of vocational education are permitted under the Smith-Hughes and Vocational Rehabilitation Acts to provide facilities through the local boards of education for training teachers for those engaged in industry.

Very wisely have these powers been directed toward the training of foremen, on the ground that foremen were the teachers of the men in their departments. Therefore, under the law it is possible to use public funds for foreman training. It is then possible in almost all places in the United States to enlist the services of the local board of education in assisting with foremen's training. This training is usually given under the name of foremen's conference for reasons which are obvious to those who have had experience with foremen.

The large majority of foremen have come up from the ranks of the workers. They have been selected because they possess certain characteristics which make it possible for them to render greater assistance in getting out the work. The ordinary foreman's way of thinking differs only in degree from that of the workman whose activities he directs. He is naturally suspicious when he is called into a production conference and told about a new policy or given directions for changes within his department. He wonders what is being put over.

If his name is listed among those to take foreman training he will accept the appointment just as he would accept any other order given him by a superior. He will do his best to enforce every letter of the law and to be able to say "I did just what you told me to." He may not be at all convinced that the training will be useful to him or that it will promote the interests of the company. Half of the time he will look upon it as a means of "getting something on him."

In view of these facts, executives have done wisely to call in the Smith-Hughes men and have the latter carry on training by the conference method.

It is better for the leader of such a group to be a person who has no authority over the group. It is therefore a mistake for the initial foreman training to be carried on by a conference leader who is a member in authority in the organization. Only in the rarest instances will he be able to gain frank and fair discussion and a full expression of those ideas which it is most important that the members of the group consider. It will always be felt that such a person will make use of information brought out, possibly in a hostile manner.

The outside training group leader, however, must be a man of judgment who can lead the discussion wisely in directions profitable to the company. It is advisable that he spend a considerable period of time inside the factory itself.

In establishing foremen's conferences the greatest care must be taken that the method used shall inspire confidence. Wise management will see to it that the entire organization is sold upon any measure before it is put into effect.

There is a decided tendency in industry for training to be sporadic. Hence we see training in industry proceeding as a succession of waves, each with its crest and trough, instead of as a steady progress represented by an inclined plane.

Present Basis of Gear Tooth Forms Questioned

H. W. Alden working on fundamentally new development. Gear grinding gets attention of production men.

By K. W. Stillman

THE statement of Col. H. W. Alden, chairman of the gear production session, of his belief that the present basis of gear tooth forms is all wrong, his announcement that Timken Axle Co. is engaged in the development of a new type of gear, and a very general interest in the possibilities and limitations of gear grinding were the chief developments of the gear production session.

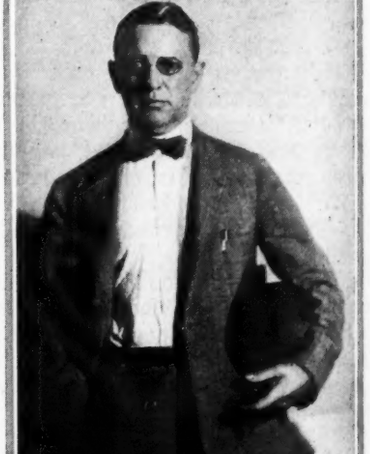
While Col. Alden did not go into any details concerning the new gear work in which he is engaged, he intimated it is along the lines followed some years ago by C. E. Logue, who believed it to be possible to establish certain standards which would produce the particular type of gears best for any given purpose. The Timken developments are still in the paper stage, but Col. Alden expects to have some interesting practical details for later presentation.

The high wear value of cyanide treated chrome steel and the even better value of chrome vanadium steel after cyanide treatment were given by P. L. Tenney, Muncie Products Division, General Motors Corp., as the outstanding results of a long series of tests conducted by his organization in connection with gear wear and noise.

Answering questions brought up in the discussion of his paper on "Coordinating Designs and Production Methods in Gear Development," Mr. Tenney said that tooth form has a far greater influence on pitting than either the steel used or the hardening process. He hasn't found it possible yet to use plain bearings successfully on transmission gear shafts but through his development work it has become possible to use lighter sizes of roller bearings.

Grinding, Mr. Tenney said, tends to shorten the life of cyanide treated gears and to increase the life of lead pot and electric furnace gears. To get the full value of grinding, he pointed out, it is necessary to consider seriously the entire metallurgy and heat treating processes of gear production. He believes it advisable when grinding to stick as close as possible to the true involute form of tooth.

His company is now using a 6150 steel with a carbon range of 5 points, but it is quite possible that further tests may make changes advisable. Cyaniding does not make gears noisy, Mr. Tenney said, but it does raise the pitch of the noise slightly. Nor does cyanide treating increase the distortion of gears; on the contrary, he said, it tends to lessen distortion because of the better quench.



Col. H. W. Alden, Timken-Detroit Axle Co., presided at the gear production session and announced that he has under way development of an entirely new type of gearing

An abstract of Mr. Tenney's paper appears futher on.

Gear production offers many difficulties, one of the most important being the lack of accurate means of measurement which can be used as part of mass production equipment. Improper mounting of gears also was given as a possible source of poor operation which might prove as important as inaccurate gears. Earle Buckingham of Niles, Bement, Pond Co., in his paper on "The Problem of Gear Production," suggested the lack of simple, rapid and accurate measuring instruments which brought from R. S. Drummond of the Gear Grinding Machine Co., a description of two types being used in that plant.

One of these compares the movement of a rack operated by a gear from production with a rack operated by a micrometer movement. This gives very accurate results but is slow. Mr. Drummond's company has another device which compares directly the relative rack movements

caused by a production gear and a master gear. This method can be designated as a production device since comparisons which are accurate can be made in 13 sec.

In reply to a question, Mr. Drummond said that he does not care for the so-called "jiggle" test for gears because, although it shows whether or not there is something wrong, it does not show what is wrong or how the defect might be corrected.

Col. H. W. Alden asked if the physical limitations in transmission designs are not a prevalent source of gear troubles because of shaft distortion caused by bearings being placed too far apart. Mr. Tenney replied that in the experience of his company it is possible to make shafts strong enough and place bearings in such a position that distortion is quite negligible.

A question raised concerning the relative difficulty of cutting gear with long addendum teeth and stub teeth was answered by Mr. Buckingham with the statement that although more metal must be removed from long addendum gears, the radius of curvature is greater, so ease of machining is not decreased.

Mr. Tenney added that special cutters are required for long addendum gear cutting but that they are no more expensive than ordinary cutters and the use of gears which are designed to meet the particular requirements is the most economical. He cited an instance where three different sets of gears were used in the same transmission. Although special tools were required for this job results were more satisfactory and the actual saving in tools over a transmission of usual design was in the neighborhood of $60,000.

Tenney Says Automotive Gears Have "Just Growed"

THE Muncie Products Division of General Motors Corporation has arrived at the conclusion that very little is known of what materials gears should be made, how they should be processed or what size they should be. This conclusion, it was brought out by P. L. Tenney, was arrived at after considering the fact that present gears have evolved through a modified process of evolution which, for each new gear requirement, adapted an existing type instead of abandoning tradition in a search for the "one and only." Mr. Tenney said that his company has had considerable success with cyanide treatment as a means of increasing gear life and that attempts at equalization of active tooth surface on each pair of gears has resulted in increasing life and decreasing weight of transmissions. An abstract of Mr. Tenney's paper follows:

Our motor car transmissions of today are a very fine example of evolution. The materials we use, the designs we use, even the functional requirements are a sum of the developed demand and the process of the material available, and most of the major steps have come about through commercial expediency and not through pre-laid down figures of the designer.

A laboratory and dynamometer analysis of our product showed that it was in every way up to the average as compared with several specimens of our contemporaries' output. We found evidence that the other fellow had troubles very similar to ours and his answer was about the same. He was using the best materials, designs and processes that they had been able to develop.

Throughout our entire preliminary investigation there was evidence that if we could coordinate the high points found in each specialty from the steel mill, through the heat treatment, through the details of tooth form, through mathematics of gear action, and the process of manufacture that some big strides could be made, both in the performance and the cost of the product.

Realizing to what extent the present product was the result of adopting one commercial development after another, and also to what extent our entire industrial substance had been built up through the purchase of equipment and the training of men along the established lines, we endeavored to abandon all loyalty to the present status of things and to assume that, should we be called upon to design the best transmission, judged from the horsepower-hours, dollars standpoint, we did not know what materials to use, what process to use, or what size to make it.

Delving Into History

To substantiate this, let's review a bit of history. The first horseless carriages used belts, frictions, or gears to secure the desired driving ratios. The fact that gears could transmit the required power with very much less space and with much more reliability quickly eliminated the other means, and the motor car maker turned to the gear specialist for his best product. He took what we might call the Brown & Sharpe 14½ deg. pressure angle, involute form cut gear.

Wear on the soft steel gears in planetary and individual clutch type of transmission and the advent of the sliding-gear transmission immediately called for a hardened gear tooth. The best commercial development available was the pack hardening of low carbon steel. This material, however, had such a low permissible stress that when used on the 14½ deg. pressure angle, involute tooth, of full depth it made stripped gears the nightmare of the motorist.

The gear maker answered this with a 20-deg. pressure angle stub tooth involute gear, still on the interchangeable system, which having a broader base and a reasonable gear action did much toward overcoming the stripping of teeth. A very few makers at this time went a step further and developed the 20-deg. pressure angle, full-depth tooth, which gave a better gear-tooth action and sacrificed very little on strength.

After the advent of the high carbon alloy steels, did we check back to find the best tooth form to use to take advantage of the physical characteristics of this steel? We definitely did not. We continued with our 20-deg. stub tooth, because this was the best thing we had developed to date. We accepted what pitting and wear we got as inherent in this type of steel.

Wear Becomes Serious Factor

Under the commercial pressure for lower cost and lighter units, we began calculating closer to the higher stress values of our alloy steel and making our transmission smaller, finally getting to a point where wear and pitting became serious factors. A very few manufacturers, realizing that the full-depth tooth had a better wear value and a better tooth action than the stub tooth, went back to the use of 20-deg. pressure angle, full pitch teeth, on all or at least the countershaft constant mesh gears and the intermediate gears, thus making half a step in the right direction.

The first accusation we had to answer was that our gears wore and pitted because they were soft. This came about through the tendency of the shop to run to the low range of the hardness specification as a precaution against distortion. We were using a chrome carbon steel of 5150 S. A. E. analysis. Short runs on the dynamometer

P. L. Tenney, Muncie Products Division, General Motors Corp., outlined gear development work carried on by his organization

readily showed that within a liberal range either side of the specified hardness there was no appreciable change in the wear value, and going a step further, we water quenched some of this steel to 96 shore hardness and got practically the same pitting and wear value as we did from soft specimens at 65 shore hardness, thus we immediately relieved the shop of the soft gear trouble.

The next step was to determine the very best treatment for the steel we were using. Upon finding the highest performance of our 5150 steel we checked this by similar test through practically the entire series of high carbon oil hardening steels. In every case a metallurgical representative from the steel mill source worked with our metallurgist so as to take advantage of all the knowledge available for getting best results of each type of steel. In these tests we went thoroughly through chrome carbon steel, chrome vanadium, chrome manganese, manganese molybdenum and chrome nickel, using both lead pot, salt bath, cyanide and electric furnace heat treatment.

Same Conditions Throughout

All through these tests the same gears, the same tooth form, the same dynamometer loads and speeds were maintained. Special attention was paid to the cyanide heating of these steels, as it was found that two of our contemporaries were using this type of steel and getting outstanding results, the main difference between their treatment and the others being that the finished product was heated in cyanide bath for its final quench.

The conclusion reached was that there was very little difference in the performance of any of these steels with normal treatment. The two outstanding features were the high wear value of chrome steel cyanide treated, and the still better value of chrome vanadium steel when cyanide treated.

Cyanide treating of a 7-9 pitch gear set upon which we were having trouble from period noise which occurred after very slight wear allowed the shop an immediate way out. The dynamometer test of this gear set showed that pitting on the original treatment was traceable within two hours and that the average life of this set was eight to 10 hours on full rated dynamometer load, whereas the same set cyanide treated without any other modification gave an average life of 30 hours.

By some fifty comparisons to which transmissions of known mileage, in known territories, were compared with dynamometer, gears of various stages of wear with known load and time were checked up, together with a comparison of material analysis, impact value, structure and hardness, a low value of 1000-mile car use per hour of dynamometer in intermediate gear was established. A high value of 8000-mile of car use per hour of dynamometer load in intermediate gear was found. All figures indicate a safe average of 3000-mile of car use per hour of dynamometer load in intermediate gear.

In measuring the life of a gear set, we determined by comparison with field test jobs the amount of wear permissible before objectionable noise occurred, setting for a standard the point at which the gears would be replaced if the car were being overhauled. We also found that the cyanide treated chrome vanadium 7-pitch gear set with otherwise the same design practically eliminated pitting and that a life of from 100 to 125 hours before any perceptible wear showed, and that better than 200 hours could be counted on as an average life of the gear. A 3½ per cent nickel pack hardened 7-9 pitch gear run on the same test showed 72 hours before a noticeable wear and an ultimate life of 150 hours.

The same general characteristics apply not only on the fine pitch passenger car units, but to the heavier pitch heavy duty truck gears as well, although the exact ratios are not maintained.

Returning to our modified addenda set, it was quite apparent that wear on our gear teeth bore definite relation to the square inches of active tooth, rather than to merely the pressure per lineal inch on the tooth. This led us into an endeavor to make the square inches of active tooth surface on each pair of gears as near equal as possible, that is to make the active tooth face on a pinion as much greater than the active tooth face on its mating gear as its ratio to that gear. By balancing out a transmission design in this manner we have been able to take 20 per cent off the weight of a transmission of a given capacity.

Accurate Means for Measuring Needed in Gear Work

EARLE BUCKINGHAM, of Niles, Bement, Pond Co., said that one of the principal difficulties in present gear production methods was the absence of accurate measuring instruments which could be used as everyday shop tools rather than laboratory equipment. The necessity for great skill by workmen as opposed to the prevailing plan of subdividing labor so that individual workmen do not have the same interest in their work as formerly was given as another production problem. He said in part:

The first essential to satisfactory production of gears is suitable means of measuring the results obtained. We must be able to detect and measure definitely any troublesome errors before we are in position to correct them.

Not knowing exactly what we must produce, we must proceed to consider ways and means for producing it. One thing we do know, however: That is, on gears very small errors make very large troubles. Small errors in profile or small errors in spacing become very apparent to the ear when the gears are operated under load. In addition, as considerable sliding action exists between the gears, smoothness of profile is essential. Furthermore, as most of the gears used in automotive construction must carry high loads and often withstand considerable abuse, they must be hardened. Thus the production department is called upon to meet a very high degree of precision under the most unfavorable conditions.

Methods of machining gears may be roughly divided into two general classes: forming and generating.

The forming process is the oldest, and is represented by form milling the soft blanks and form grinding the hardened blanks. The difficulties encountered here led to the development of various generating processes.

These generating processes may be divided into two general types; the first where the generating tool represents the form of the basic rack of the gear system, and the second where the tool represents one of the gears of the system.

The hope that a generating process would eliminate all trouble in the production of gears has never been realized. Generating has eliminated some of the difficulties encountered in the forming process but it has also introduced a few little difficulties of its own.

A burnishing process has been developed, which smooths the profiles of machine gears by crowding them into accurate hardened and ground burnishing gears. This process will make a good gear better, but it will not make a bad gear good.

One thing after another has been tried to eliminate or minimize the difficulties of producing good gears. Refinements cost money. The usual order of the day is to reduce production costs. But it is a very difficult thing to refine the methods and reduce the costs at the same time. The final correct solution, if it is ever arrived at, must do this however. This reduction in cost may come from a reduction in the amount of scrap and salvaging charges. It may also come from the eventual development of a manufacturing process that produces better work with less productive effort. It has been done in the case of cylindrical surfaces by the development of cylindrical grinding machines and a similar development may take place in the production of gears.

The introduction of gear tooth grinding has not of itself yet cured all troubles. In the first place most of these machines are made adjustable. This makes them very flexible as regards the product, a very desirable feature in jobbing machines but a detrimental feature in many ways for production machines. Ease of adjustment makes it possible to correct faults readily but it also makes it possible to introduce faults just as readily. Here the lack of simple and rapid testing means is apparent and is indeed felt very strongly.

To my mind, the largest part of this production problem, and all production problems, is the human equation of the workmen who are to operate the production equipments. The modern plan of subdivision of labor tends to eliminate all interest on the part of the workman in what he is producing. The production of the complex surfaces of gear teeth requires considerable technique on the part of the operator if the best results are to be obtained. This is particularly true of the grinding processes. At the present time, as much depends upon the machine operator as upon the machine.

Safety a Live Topic at Second Tool Session

Accident prevention aids production. Standard tools and fixtures recommended. Budget applied to machine maintenance.

WHILE the second machine tool session did not develope the widespread differences of opinion which characterized the first, its interest and value were no less. The topics presented were followed closely and discussed by both machine tool builders and production men. However, in this case speakers in both fields were in rather close agreement. The subjects dealt with a diversity of topics which embraced tool and fixture design, safety provisions throughout the plant, and an analysis of the maintenance characteristics of several of the widely used classes of machine tools. In the absence of L. L. Roberts, John Younger presided and also read the paper prepared by A. R. Kelso of the Continental Motors Corp.

In the first paper, "Jigs and Fixtures in Automotive Production," J. Gustaf Moohl of the Cleveland Automobile Co. dealt specifically with the fixture equipment for the cylinder line and emphasized the advantages of standardizing design to permit the use of one pattern for as many points as possible. More careful consideration in the drafting room stage will allow this practice in many cases and will permit the use of more elaborate castings with a considerable reduction in total cost. Among other high spots were his insistence for the closest cooperation between the product and tool designing departments and his advocacy of cam operated clamping devices and more rigid construction.

From purely mechanical considerations, the attention of the meeting was diverted to the consideration of employee's welfare and the benefits of safety provisions and accident prevention by the paper, "Making Machine Tools Safe" by R. F. Thalner of the Buick Motor Co. Aside from the purely humanitarian considerations, he asserted that safety provisions are most profitable and in many instances where steps to prevent accidents have been taken, the cost of production has been reduced by the greater confidence of the workers. Moreover, a loss is bound to follow whenever the regular operator of any part of the manufacturing scheme is disabled and compelled to leave his station as the result of accident.

By way of introduction, Mr. Thalner presented the figures covering accidents at the Buick plant for the last three years. These demonstrate the advantage of safety provisions in an emphatic manner as from a figure in excess of 1600 in 1923, the number was reduced to 750 last year and based on reports so far for this year will be about 570. America has been most prodigal of human life as shown by comparative figures for accidental fatalities per million of population per year. The figure for this country is 860, nearly 400 more than that of Great Britain in second place, and the latter is followed closely by France and Japan while Denmark shows a figure of 223.

Chief Cause of Accidents

Spasmodic increases of production are charged as being the most prolific sources of industrial accidents as shop facilities are not improved to meet this change from existing conditions. Forethought in planning safety means is the greatest contributor to accident prevention and best results are achieved by designing machines and setups so that safety is an inherent feature. If this is not possible, adequate guards should be installed. The following were emphasized as being outstanding preventatives for the usual run of industrial accidents as related to the usual automotive shop.

1. Gloves or long sleeves should not be worn by drill press operators.
2. Chips never should be brushed away from any types

of cutters by the hands. Either a brush or stick should be used.

3. All belts and gears must be covered.

4. Tools or drills should be ground so as to break up the long ribbon-like chips which are seen in many shops.

5. In the salvaging of high speed steel drills, etc., screens or similar provisions for the prevention of flying chips should be used.

6. Guards should be placed around drills.

7. Milling machine cutters should be covered.

When turning brass, the chips tend to fly at high speed due to the characteristics of the metal and the speed of the operation. Metal guards should be placed over the cutting end of the tool in order to deflect chips into the scrap pan. In punch press practice, guards and interlocking levers do not seem to supply the complete solution of accident prevention. Better results have been achieved by making the punch and die arrangement safe by the arrangement of the design of loading chutes and similar devices. When large sheets are going through the press, the metal should be handled by tongs.

Better Grinding Wheels

Grinding wheels no longer are the deadly weapons of a few years ago, the change being due to better wheel construction, the use of resilient washers, adequate guards and exhaust systems. Along with these improvements, wheels are inspected closely before installation and speeds are controlled carefully. Goggles are to be recommended for snagging operations as well as for much of the maintenance work, such as driving keys in the forge shop.

In the wood shop, shaper and saw forms must be used liberally in order to keep the workman's hands away from the high speed cutters, which are exceedingly sharp. Buick has found that the use of circular heads on joiners is less conducive to accidents than is the older square head. Small tools, such as hammers, and the shock tools, including chisels punches, etc., are responsible for many accidents. For driving nails, a bullseye hammer is superior. This type of hammer has concentric grooves in the striking face and these prevent nails from flying in case of a glancing blow.

Chisel and punch heads should be formed with a radius in preference to the flat top or chamfered edge. The radius, which should measure from ¼ to ⅛ of the diameter, prevents chipping off and the formation of flying particles for much longer periods than do the other two shapes. In some work at the Buick plant, the chisel with the radius form performed 4800 operations before redressing was required, whereas another chisel with a chamfered top lasted through only about 400 operations.

As a concluding thought which applies universally, Mr. Thalner urged production men to remember that accidents do not "just happen," but are caused. Both machine tool builders and automotive men, among whom were included E. F. DuBrul, Eugene Bouton, F. E. Cardullo, John Younger, W. G. Careins and others, entered into the discussion. All came out strongly for accident prevention but criticized the make-up of State safety codes and the type of factory inspector, usually a political henchman, who is entrusted with the interpretation of these codes. Most of these concentrate on belt guards and overlook the more important sources of industrial accidents.

In the third paper, "Analysis of Machine Tool Maintenanec," which was prepared by A. R. Kelso of the Continental Motor Corp., but presented by John Younger in the absence of the former, the results of a statistical analysis of machine tool breakdowns were shown with a budget scheme which has developed the first actual figures as to relative values of various types of machines. Figures for eight common types of machine were shown with average figures for the number of machines which were shut down for any repair during the month and still other figures covering the extent of the repair job. Extent was defined as the average total time spent on repair divided by the total number of machines. These are listed below.

Kind of Machine	Total Machines In Use	Frequency Percent	Average Extent Hours
Single Spindle Drills	309	32.2	1.83
Grinders	253	61.4	6.52
Automatic Lathes	130	64.5	6.80
Horizontal Milling	105	38.9	2.84
Vertical Milling	46	24.8	3.00
Gear Cutting	275	45.2	2.394
Multi-Spindle Drills	77	70.0	10.00
Turret Lathes	315	58.3	6.89
Single Spindle Drills	309	32.2	1.83
Two Spindle Drills	51	31.4	2.32
Three Spindle Drills	25	32.0	2.95
Four Spindle Drills	19	47.8	3.5
Six Spindle Drills	18	61.8	7.68

This analysis was followed by another table showing the location of the required repairs which generally took the following order: spindle and bearings, feed mechanism, main drive, pump, clutch and work head or table.

This analysis was followed by an outline of the budget scheme in which an allowance for repairs is based on the value of the machine in units of $1,000. The budget is built up on a similar frequency factor and a comparison of the excess required over the time allowance. This paper was received with the utmost enthusiasm, particularly by the machine tool builders whose sentiment was crystalized by Mr. Du Brul, who asserted that effort of this nature is the sort of cooperation which is bound to benefit both industries. Further, he stated that to his knowledge this is the first time that anyone has got together tangible facts and figures which can be subjeced to analysis instead of the usual blind hunch of guess.

Machining Methods Used for Engine Blocks

CLOSE cooperation between the tool department and the engineering department is needed if jigs and fixtures are to attain their greatest possible value as aids to production. The Cleveland Automobile Co. has achieved considerable economies in jig and fixture costs, in production costs and in operating time by this means and a brief outline of what they have done and how they did it was given by J. G. Moohl in a paper which follows, in part:

In designing jigs and fixtures for large or medium production there are several factors the tool engineer must consider, among the most important being accurate location of the work; firm but rapid clamping facilities and loading means; reduction of expense by similarity of patterns, bushings, and other parts; and the general design of the fixtures themselves.

We consider that cooperation between the engineering department and the tool engineering department is of utmost importance; and in line with that idea, it was decided that the tool engineer should determine the position of locating points for machining operations on the engine block.

To insure long life and successful operation of the jigs, dowel holes must be large enough so that the locating pins and dowels may be of ample size to withstand wear and

E. F. Du Brul, general manager of the National Machine Tool Builders Association, who presented the case of the machine tool men in the discussion of their relations with the automotive industry

At left—J. Gustaf Moohl, Cleveland Automobile Co., who read the paper on "Jigs and Fixtures in Automotive Production." R. F. Thalner (right) of the Buick Motor Co. contributed many interesting thoughts on the subject of "Making Machine Tools Safe"

strains. Disappearing dowels are used throughout so that loading may be accomplished by sliding the heavy casting in on hardened strips without lifting it over any protruding dowels or pins.

A jig that is not quick-acting will usually prove to be a costly piece of equipment. The average reloading time for all jigs in the engine block department at the Cleveland Automobile Company is 12 sec. For heavy work, such as motor castings, if all obstructions which the piece would have to be lifted over are eliminated, and stops to locate it approximately are used, the loading time will be greatly reduced.

A number of operations on the same piece may be performed with jigs having bodies cast from the same pattern. Frequently a whole series of jigs may be designed so that by changing a boss here and there, or perhaps adding a loose piece or two, one pattern serves for the jig bodies of all. Six jig bodies used in machining Cleveland Six engine blocks were cast from the same pattern.

Appreciable expense is also saved by using in every possible case a single type of standard removable liner bushing. A removable liner bushing, kept in stock in standard sizes requires only that the machine be stopped a maximum of 2 or 3 min., while the old one is lifted out and a new one slipped in without the aid of a single tool. The loss of time to the machine is therefore a matter of a few minutes against perhaps a half a day with drive fit bushings.

By using duplicate clamping parts, handles, knobs, screws, etc., on as many jigs as possible, not only will much time be saved in the drafting room but also a smaller stock of replacement parts will be needed.

It is important that all locating surfaces be self-cleaning. Surfaces may be sloped away from horizontal locating points, so that chips will roll away. Vertical locating surfaces can usually be placed high enough above any horizontal surfaces so that chips will not accumulate in front of them.

As an example of the extent to which cooperation between the engineering and tool engineering departments may be carried, the matter of boring cam and crank holes in the Cleveland Six engine block may be cited. This is a 3 bearing job, and at the tool engineer's suggestion, the cam and crank bores were designed in steps, that is, starting at the front each successive bore is stepped up to a slightly larger diameter, and with this design a much more efficient method of boring is made possible.

Discuss Hot Stamping and Material Salvage

Use of hot stamping for small runs and quick production and material conservation, sheet metal session topics.

HOT stamping of sheet metal in which the metal is drawn out nearly to its elastic limit by a series of cold drawing operations, then heated to a cherry red and run through the dies to acquire the final shape was suggested at the sheet stamping session as a practicable and economical way of handling small runs, for producing highly complicated stampings or for getting into production quickly.

G. F. Keyes, of the Mullins Body Corp., which has been using this method, described how their dies are made and how the various operations are performed. The cost of dies for hot stamping is considerably less than for the cold drawing method and the former type can be made much quicker so that there are many times when this process might be used effectively to lower costs or hasten production.

This session also developed the fact that the Studebaker Corp. of America has been giving considerable thought to the conservation of material in its sheet metal department and has been able to increase the amount of metal used productively from about 60 per cent of the amount purchased to 88 per cent. This has been accomplished by careful determination of stock sizes, careful layouts of stampings and effective use of scrap from large pieces in making smaller pieces.

In addition to the work in material conservation, Studebaker has done considerable toward developing machines and equipment for assisting production in their sheet metal department. These facts were brought out in a paper, prepared by Syd Smith of the Studebaker Corp. The paper, in Mr. Smith's absence, was read by R. I. Mowery.

John Jaschka, National Malleable & Steel Castings Co., presided at the sheet steel session

In the discussion of Mr. Keyes' paper it was brought out that hot stamping is applicable to other automotive parts beside body stampings. In parts such as brake drums, where great accuracy is necessary, hot stamping would not be advisable but in many other parts it could be used satisfactorily. An advantage of this method is that stampings which are so complicated that several dies would be necessary to produce them by cold drawing often can be stamped hot with the use of only one or two dies. The cost savings in such instances are obvious.

There is no strict dividing line between hot and cold stamping as the most economical method. The complication of the work to be done is a strong influencing factor. If many expensive dies would be necessary for cold drawing more stampings could be made economically by the hot process. The life of a hot stamping is indefinitely long. Mr. Keyes cited the case of a die which his company had been using for eight years in production of one type of fender for Pierce-Arrow cars. Dies which include beads will not wear so well, the usual life being between 1500 and 2000 stampings.

One disadvantage of hot stamping is that heating the steel often causes scale to form which, of course, must be removed by sand blasting or some other method. Also some of the scale is likely to fall between the die and the stamping causing pits. An effort is made to keep the temperature of the steel below the scale forming point and the range is from 900 to 1200 degrees. Stampings made from the hot process are stiffer than cold drawn work.

Hot Stamping Proves Economical for Small Production

MR. KEYES, in his paper on "Hot Stampings," pointed out that hot metal stamping for automotive work is practicable when production is relatively small or when the complexity of the stampings would make the expense of making dies for cold drawing excessive. He described the methods used by his company in making hot press dies and in using them in manufacturing processes. One important feature of hot press work is the speed with which production can be started. It often has been found advisable, where it was necessary to get manufacturing operations under way quickly, to start with hot press stampings until such time as dies for cold drawing could be made. Mr. Keyes said in part:

Either wax, wood or plaster-paris models can be used. The type of model is determined by conditions. If the designer prefers to make an outline drawing of a fender or body panel and work out details in the model, wax is the best material to use. Plaster models are used when a reproduction of a handbuilt body or fender is desired. A plaster cast can be taken from the sample panels and a re-cast made therefrom and the re-cast set up in the form of a model. When complete body drafts are available and the design is predetermined, wood models are preferred, made in the conventional manner. All models should be made to outside of metal for hot stamping use.

Taking Off the Casts

After models have been finished, the next step is to take off plaster-casts from the models. These casts are built into patterns representing finished dies. From these patterns semi-steel dies are cast. This requires a special set-up in the foundry, so that dies come out of the sand true to pattern. There is enough shrinkage in the metal to allow for finishing the die surfaces.

Stampings can be made in a drop-hammer press or a single-action press, depending upon the type of stamping to be made; before dies are set in the press they are filled up with what is known as "pick-ups." A pick-up represents one drawing operation. We predetermine how many drawing operations are going to be necessary to make the stamping and fill the die with the number of pick-ups required; this usually runs from 3 to 7, depending on depth of draw. Pick-ups are usually made one inch thick. After all the pick-ups have been made, the die is set in the press to have the male portion of the die cast; an improviso mold is made around the top of the die and lined with clay; then this mold is filled with molten lead that forms the top die. As soon as the top die is cold, it is attached to the ram of the press and raised clear of the die; a heavy gage plate is placed on top of the pick-ups, and the top die is dropped, if drop-hammer is used; or squeezed, if set in a single-action press.

This operation forms the heavy plate into the shape of the first operation; this plate is attached to the upper die, and stampings are then run through the press and partially formed; this is done cold and is called breaking down. This operation is repeated until all pick-ups have been removed from the lower die and attached to the upper; then a new upper die is made to conform to the exact shape of the semi-steel die.

G. F. Keyes, Mullins Body Corp., talked on hot stamping methods

The upper die is then covered with a heavy gage stamping with an asbestos lining between the stamping and the lead die to protect the lead from the heat. After the new die has been made and lined or covered with steel and asbestos, the hot run is made, stampings are heated to a cherry red and run through the dies. This operation requires considerable skill, as all shrinkage and imperfections are removed in this operation. After the stampings have been run hot and cooled off, they are re-run through the die with irons added to the die to sharpen all corners and to set beads, also to take out shrinkage caused by the cooling of the stamping.

T. R. Mowery, Studebaker Corp., who presented Syd Smith's paper on "Sheet Steel Fabrication"

Conservation Methods Saves 30% of Stamping Material

ELIMINATION of waste, particularly in materials, was the subject of the paper prepared by Syd Smith of the Studebaker Corp. of America. As an indication of the importance of this item when applied to sheet and strip metal, he said that from 25 to 30 per cent of the weight of an automobile is produced by the weight of the sheet and strip steel used in its construction, and as about 60 per cent of the cost of a sheet metal piece is in the stock the opportunity of saving by eliminating waste is apparent.

As the first step toward conservation of material, Studebaker endeavored to lay out the larger pieces so that the least amount of waste might result and then made use, wherever possible, of these waste pieces for making smaller parts. In this way it was possible to increase the amount of sheet metal actually used in production from about 60 per cent of the total purchased to 88 per cent.

There are so many small pieces of scrap resulting from the production of larger pieces and so few small parts used in a car that it was found to be impossible to salvage all material even though it was of fairly good size. This led to considerations of the advisability of welding several of these small scraps and using them for various production requirements. Experiments along this line have not progressed far enough so as to able to determine definitely the advisability of this procedure. Mr. Smith is of the belief that it offers possibilities. It was suggested that phaeton tops might be made of a single sheet of welded steel.

By the use of a number of lantern slides the methods being utilized at the Studebaker plant in sheet metal fabrication were shown. In making the shroud for their Phaeton each half is roller leveled to present stretcher strains, and is cut and pressed. The two parts are then placed in an automatic butt welding machine which makes a firm joint in a very small portion of the time required by spot welding. The current cost for this operation was given as ¾ cent per weld. The shroud, shroud panel and dash are spot welded together on another automatic machine which operates automatically.

Considerable work has been done to provide machines and equipment for facilitating and speeding up production. A large automatic welding machine has been developed for joining the two side panels to the back. While undergoing the finishing operations before being sent to the final assembly line, the body is mounted on a cradle which, in turn, is mounted on a truck. The cradle permits the body to be turned in any position so that workmen can have direct access to the part being worked upon.

Discussion of Mr. Smith's paper brought out the fact that roller leveling does not entirely eliminate stretcher strains but does relieve this condition considerably. Sheets stamped immediately after rolling show the least amount of strain.

Welding of parts has been quite satisfactory. The welds stand up well under vibration and are strong. They make necessary but very little extra work in order to prepare their surface for finishing and this is all done in the body building department before the body is delivered to the finishing department.

R. B. Schenck, Buick Motor Car Co., who read the paper on "Inspection Methods" in the absence of C. J. Rodd

J. J. Feeley, Glenn L. Martin Co., who outlined the inspection problems of the airplane industry

Noise and Accuracy Interest Inspectors

Need for scientific noise measuring instruments and methods for controlling quality arouse discussion.

THE expression of the need for scientific instruments for measuring engine and gear noises, methods of keeping production foremen and men interested in doing careful and accurate work, and a brief discussion of the possibility of paying inspectors on an incentive basis were the main developments of the inspection session Wednesday afternoon.

It seemed to be the consensus of opinion that present methods of inspecting for quietness are not entirely satisfactory. Although an expert inspector can determine with a fair degree of accuracy the relative noisiness of different parts, his judgment is influenced, it was said, by production conditions. When things are running smoothly he maintains high standards but when difficulties arise he is likely to lower his standards of performance considerably.

The development of an instrument for measuring noise was thought to be desirable and such a development should be in considerable demand. Various suggestions were made as to the lines along which such development might be carried, in all of which Dr. St. Johns was very much interested.

As part of the paper prepared by C. J. Ross of Buick Motor Co., and read in his absence by R. B. Schenck, several lantern slides were shown giving proportion of inspection costs to labor costs. These raised a question in the mind of R. I. Mowery as to why there should be a decided fluctuation in these proportionate costs. In reply Mr. Schenck said that two factors, change in production and occasional carelessness of production formen and men, were the probable causes. A. H. Frauenthal, Chandler Motor Car Co., who presided at the session, stated that it had been his experience that the use of a group bonus wage system was the most effective means of keeping the quality of work constant. When the entire group was penalized by the poor work of any member each member of the group took great interest in having all parts right and the work of inspection was reduced.

Payment of Inspectors

A question was raised as to the practicability of paying inspectors by some sort of incentive system. The general expressed opinion was that although it might be possible in particular instances it was impossible ordinarily. Payment on a time basis was thought to be the most satisfactory method.

In a paper titled "Some Aspects of Inspection in the Airplane Industry," John J. Feeley of Glenn L. Martin Co. gave an explanation of the different parts of an airplane, their manner of functioning, some principles of design and some of the considerations necessary to the proper development of an airplane, all as a prelude to the discussion of the inspection problems arising in the industry.

A discussion of the relation of the contractors inspection with the customers inspection led to an explanation of the control exercised over raw materials and raw stock inspection, covering methods of handling material, detecting flaws, etc. Reference was made to inspection of purchased assemblies, detail inspection of metal parts and processes and the function of the inspector in this work.

A. H. Frauenthal of the Chandler Motor Car Co. presided at the inspection session

Assembly inspection was discussed with regard to accuracy of completed assemblies, fuselage line-up and installation of various sub-assemblies. Final inspection included such items as tests of radio bonding, engine installation, oil, gas and water systems, and general line-up of the airplane.

Buick Keeps 15 to 1 Ratio Between Workmen and Inspectors

MAINTENANCE of quality is very important in automotive work and the only way it can be accomplished so that cheap labor can be used for assembly operations is to have an adequate inspection force which, in the view of the Buick Motor Car Co., means not more than 15 productive men to each inspector. In the Buick plant, each department is budgeted for the amount of inspection work required for the particular operations performed and it must turn out good work, properly inspected, for the budget inspection allowance. The average number of productive men per inspector varies from about 11 to 14.

In a paper prepared by C. J. Ross and read, in his absence, by R. B. Schenck, the complete inspection program of the Buick plant was given. Not only their methods but complete, illustrated descriptions of a number of specially designed inspection tools were included in the paper which, in part, was as follows:

Inspectors have been called a necessary evil. Formerly, under the apprenticeship system, mechanics were well trained and the work turned out by them was of so high quality that inspection was perfunctory. But the day of apprenticeship has passed; there is no incentive to learn a trade, and the chief ambition of young men is to secure a position on the assembling line where they can make

money, for any novice can be taught quickly to insert a cotter-pin, and he can make more money doing it than he can by hiring out as an apprentice.

The only way in which cheap labor can be used for assembling and the product be held to the required standards is to make the parts fit. With adequate inspection, parts can be held closer to limits and cheaper labor can be used to put them together.

When the ratio of productive men to inspectors does not exceed 15 to 1, no excuse exists for failure to maintain standards. In the Buick Company, the average number of productive men per inspector was 12.75 in March; 11.28 on May 30; and, during the week ending August 8, it was 13.3.

Throughout the works, a certain ratio of productive hours to inspection hours is allowed in each plant, depending upon the nature of the work. This amounts to practically the same thing as working out a budget. In no instance was the allowance exceeded.

On the principle that parts must fit accurately in order to be properly assembled, great care is taken to see that all parts meet the requirements and, as an added precaution, the engineering department continually checks the inspection department to insure that the limits called for by the drawings are maintained.

Inspection begins in the metallurgical department with the arrival of the raw material, which is thoroughly tested to make sure that every part complies with the specifications. Thenceforth, all major parts are given 100 per cent inspection with go and no-go gages of the pin and snap types. These give quick inspection and are considered better than micrometers. Parts either pass or do not pass. Limits are established beyond which they are not allowed to go.

Extensive application is made of spark testing, both of the raw material and of parts coming from the heat-treatment. By this method not only can material that may have become mixed be readily sorted, but the carton content, the presence of inclusions, and the composition of alloy steel can be quickly and accurate determined.

A TRIP which seems to prove that light plane flying at a reasonable cost is commercially possible, not only for short distances but also in long flights, has been made by Allen Cobham, flying the DeHaviland Moth described on page 830 of *Automotive Industries* of May 7, 1925.

This small plane flew from London to Zurich and back in a single day, a distance of about 1000 miles. The plane left London at 5 a. m. and, flying at an average speed of a little over 80 m.p.h., reached Zurich, 500 miles away, at 11 a. m. Here Cobham remained but three-quarters of an hour for lunch and started back for London, flying against a strong course wind which kept his speed down to 60 miles per hour, arriving at Croydon at 7.30 p. m.

The actual cost of the flight, figuring gas and oil consumed, was but about $20, whereas the same trip if taken by boat and railway would have cost well over $50. And whereas the train and boat trip to Zurich and back consumes 37 hours, the DeHaviland Moth made the trip in 13¾ hours.

UNTIL recently the functions of scientific research and technical development in the British Air Service were combined, but they have now been divided and placed under separate directorates. H. E. Wimperis has been appointed director of scientific research and D. R. Pye deputy director. Mr. Wimperis has been acting provisionally for some time as director of scientific research, while Mr. Pye has been lecturer in engineering at Trinity College, Cambridge.

MEMBERS of the British air service are to be equipped with parachutes for use in emergencies. In the recent debate on the Air Estimate, Sir Samuel Hoare announced that an order had been placed in the United States for a number of Irvine parachutes of the free type, and that deliveries would begin shortly. Through unofficial sources it has been learned that the order involves an expenditure of £150,000, and that arrangements will probably be made for manufacturing the parachute in Great Britain. The "free" type of parachute is one in which there is no connection with the machine at any point. The pilot carries it on his body and is free to jump overboard with it when emergency arises. In the Irvine type the pilot, after dropping clear of the machine, pulls a cord which opens a flap and allows a small "pilot" parachute to shoot out under the action of a spring. The resistance created by this "pilot" parachute opens out the main parachute, which when in action allows the aviator to descend at a uniform speed of 6 ft. to 10 ft. per second.

THE Societa Idrovolanti Alta Italia at Seste Colende, Italy, has issued a circular of the Pistolese variable pitch airplane propeller. A number of illustrations of the complete propeller are shown, as well as a sketch showing how the wooden blades are fastened into a metal muff at their inner ends, but there is no illustration of the actual blade rocking mechanism. It is explained, however, that the blades are set my means of a hand crank and that the operation is comparatively easy. Recent tests made with a Spad XIII plane by the Italian Aeronautical Research Bureau at the Montecelio flying field near Rome are said to have shown that when the plane was fitted with this variable pitch propeller there was a gain of 5 m.p.h. in horizontal speed, a saving of 2 min. in reaching the ceiling of 13,900 ft. (which represents 15 per cent of the total time required) and a gain of 1650 ft. in the theoretical and actual ceiling. The hand crank by which the pitch of the propeller is varied is only 2 to 2½ in. long and all ordinary adjustments are accomplished by five or six turns, while twenty-five turns will completely reverse the pitch of the blades for "braking" purposes.

ACCORDING to a statement made in Parliament by the British Air Minister, errors of judgment were the cause of more than half the flying accidents that occurred between April 1 last year and May 31 this year. The following statistics were quoted:

Causes	No. of Accidents Home	Abroad	Total
Engine or installation failure	17	8	25
Error of judgment	89	53	142
Combination of engine or installation failure and error of judgment	15	8	23
Defect in aircraft construction	2	3	5
Defect in aircraft design	7	..	7
Defect in aircraft maintenance	1	..	1
All other causes	29	42	71
	160	114	274

Machine Tool Exhibits at Steel Show Attract Automotive Men

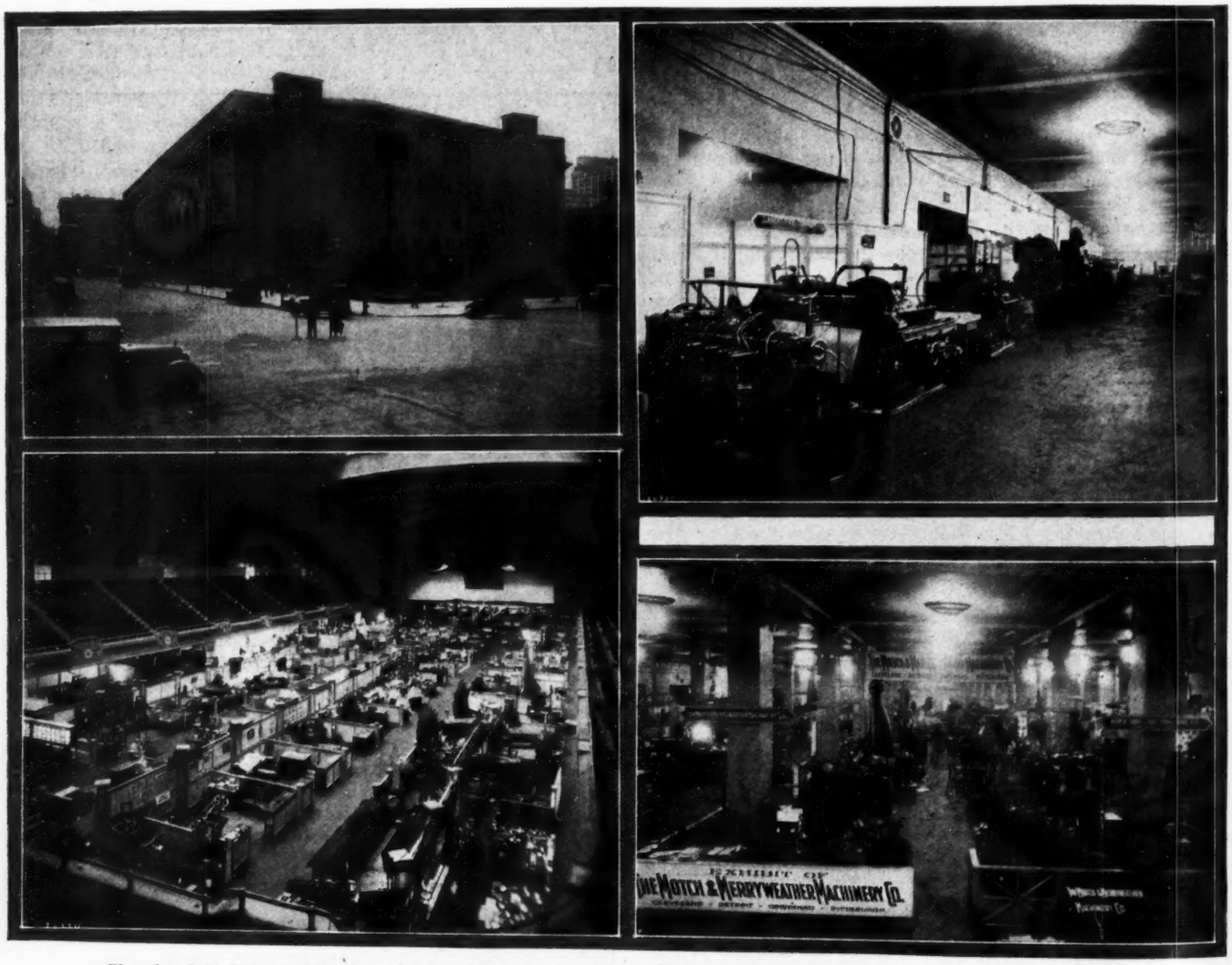
Large part of exposition in Cleveland Auditorium given over to display of production equipment. Several new machines on view.

AUTOMOTIVE men found much interest at the National Steel Exposition which was held under the auspices of the American Society for Steel Treating in connection with the A. S. S. T. and S. A. E. meetings in Cleveland last week.

Approximately 180 exhibits, which taxed the capacity of both floors at the great Cleveland Public Auditorium, included a full range of production equipment with the better known lines of machine tools in the foreground. In addition to these, small tools including drills, reamers and cutters were shown and this type of exhibit was reinforced by a very liberal showing of tool steels and furnace and heat treating equipment, including pyrometers of all kinds and many types of checking and measuring instruments.

Further down the line in material fabrication came the tool and die room equipment and several exhibits of bar cutting and forge shop machinery. A number of demonstrations of both electric and gas welding and cutting equipment drew well merited attention.

The machine tool exhibit in general was unusual and noteworthy for the reason that in practically every case the machines were shown in actual operation and this fact was a pointed commentary on the pronounced trend toward the individual electric drive, since only in a few instances did the motor mounting appear as a temporary expedient. Some hint of the automotive production slant



Cleveland Public Auditorium (upper left), scene of the National Steel Exposition. Below, at left, is seen the main floor of the auditorium and the arrangement of the exhibits. The lower right-hand picture gives a general view of the exhibits on the sub-floor, where most of the heavy machines were located. A few machines are seen at closer range above

which held throughout the machinery exhibit is indicated by a few examples of the demonstrations.

A Lodge and Shipley Duomatic was complete rough-turning on drop forged cluster gear blanks.

A Melling cam shaft lathe made by the Walcott Lathe Co. was rough-turning and necking drop forged camshafts.

Malleable iron differential housings were machined in a Potter and Johnson 6-c full automatic chucking machine. An unusual feature was a milling head on the turret. The mechanism of this head is fully enclosed and is driven by an auxiliary shaft and jaw clutch which engages with a similar clutch on the head when the turret advances at this station. The face of the milling head carried about ten end mills which milled off the pads for the differential bearing caps. The entire face of the head carrying the end mills is rotated automatically at a speed slightly greater than that of the spindle. Therefore the faces of the bosses are swept during the lathe operation. Pneumatic control is another feature of this machine.

"Unimatic" Also Shown

In addition to the machine last mentioned, which is new, the same company also exhibited another new type of machine called the Unimatic. Two of these which are automatic turning machines of the cyclic type, were in actual operation. In the first, cast iron pistons were roughed outside while in the other roller bearing outer races were rough bored and faced.

Another novel type of operation was demonstrated by the Kobert forging and riveting machine shown by the National Equipment Co. This machine combines an electric heating element and the usual vertical ram. One of these machines was engaged in riveting pliers and another in making valves and tappets where heads of one size and material were joined to stems of smaller size and different material.

Brown and Sharpe showed their latest full automatic production milling machine equipped with a motor in the base. One of the outstanding features of this machine is the spindle which reverses automatically so that the correct direction of cutter rotation is obtained when fixtures are mounted at both ends of the table. This feature is utilized with an automatic rapid traverse and reverse for the work table. Kearney and Trecker showed both vertical and knee-type electrically driven machines and with the former a recently developed fixture for continuous slotting of screw heads. The new pyramid type miller made by the Cincinnati Milling Machine Co. also was prominently displayed as was the No. 5 machine equipped with a spiral slabbing cutter.

A Gardner full electric double disk grinder equipped with an automatic fixture for grinding pin ends received considerable attention as did a Blanchard surface grinder which had a continuous washing machine installed at the end of a circular feeding arrangement. Among the internal grinders, the new Heald semi and full automatic machines and the Giddings and Lewis Teromatic were indicative of the present trend of improvement.

New Britain Chucking Machine

The New Britain Machine Co. showed its latest four spindle chucking machine with pneumatic control engaged in producing brass pet cocks. This machine is designed to turn brass at feeds and speeds which are limited only by the ability of the tools. This company also had a small automatic working on brass bar stock at production rates which attracted attention.

Baker Brothers showed a large vertical drilling machine and a cam operated production drilling machine, both of the single spindle type. In the multi-spindle field, the National Automatic Tool Co. also showed a cam feed machine along with a small cyclic-eight spindle pin drilling machine.

In the die and tool room fields, the new electrically controlled all around die tool machine made by the Keller Mechanical Engraving Corp. was in actual operation and attracted great attention. The Campbell nibbling machines suggest great possiblities for tool room and experimental shop savings. Where parts are to be made from plate, the nibbling process is much shorter and cleaner than the time honored method of drilling and breaking out.

Large Machines Displayed

As usual at shows of this kind, the big fellows got the crowd. When the big Buffalo and Pels bar cutters went into operation, the rush started. The former machine sheared 3 in. squares and 3½ in. rounds as well as various sizes of angle and channel. The Cleveland Twist Drill Co. showed a big Foot-Burt vertical drill and a smaller Colburn. In the latter a ⅝ in. drill was working in cast iron at the rate of about 69 in. per min., the feed being .074 in. and the speed approximately 850 r.p.m. Cincinnati, Gray and others showed planers taking tremendous cuts. By contrast the Ex-Cell-O Tool Co. showed a small electric driven internal grinder on which was mounted an air turbine spindle running at 65,000 r.p.m. grinding holes to 3/32 in. finished size.

A continuous electric seam welder was shown by the General Electric Co. while cam and pantograph arrangements were shown by the Air Reduction Sales Co. These machines, carrying oxy-acetylene torches, produce formed surfaces in thick stock with a finish as smooth as that produced with shaping and planing equipment. Gould & Eberhardt, and Brown & Sharpe had gear cutting equipment in operation. Both Landis and Norton showed rather complete lines of cylindrical equipments engaged in typical production operations.

Heat Treating Furnace

One of the features on the second floor was the Hagan continuous electric heat treating furnace similar to the installation at the new Ajax plant. This circular unit of about 12 ft. diameter will replace a large battery of gas fired furnaces and the work is dumped into the quenching bath without coming into contact with the air. Leeds and Northrup showed complete operating potentiometer installations while practically all of the pyrometer people were present.

Among automotive men, the major interest was in the machine tools. The feature of having the machines in actual operation on work which is typical of almost all shops made a tremendous impression and developed discussions of value to both machine tool and automotive men. Only the merits of many of the papers at the sessions kept production men from spending their entire time at the exposition.

A list of the exhibitors of machine tools, small tools, tool steels and instrument equipment follows. In this is included also the exhibitors of furnace and heat treating equipment as well as the names of other makers who supply production materials to the automotive industry:

A

Abrasive Machine Tool Co.
Acme Machine Tool Co.
Air Reduction Sales Co.
Ajax Manufacturing Co.
Allen, Charles G.
American Gas Furnace Co.
American Resistor Co.
American Stainless Steel Co.
American Tool Works
Ames, B. C.
Anchor Drawn Steel Co.
Armstrong-Blum Mfg. Co.
Armstrong Cork & Insulation Co.
Atkins & Company, Inc., E. C.
Atlas Alloy Steel Corp.
Avey Drilling Machine Co.

B

Badger Tool Co.
Baker Brtohers
Bath & Company, John
Bausch & Lomb Optical Co.
Bellevue Industrial Furnace Co.
Bellis Heat Treating Co.
Bethlehem Steel Co.
Billings & Spencer
Bilton Machine Tool Co.
Black & Decker Mfg. Co.
Blanchard Machine Co.
Bristol Company
Brown Instrument Co.
Brown Lynch Scott Co.
Brown & Sharpe Mfg. Co.
Bullard Machine Tool Co.

C

Campbell, Inc., Andrew G.
Carborundum Co.
Carpenter Steel Co.
Case Hardening Service Co.
Celite Products Co.
Central Steel Co.
Cincinnati Bickford Tool Co.
Cincinnati Grinder Co.
Cincinnati Milling Mach. Co.
Cincinnati Planer Co.
Cincinnati Shaper Co.
Cleveland Automatic Mach. Co.
Cleveland Tool & Supply Co.
Cleveland Twist Drill Co.
Colonial Steel Co.
Crucible Steel Co. of America

D

Davenport Machine Tool Co.
Davison Gas Burner & Welding Co., N. C.
Dearborn Chemical Co.
Disston & Sons, Inc., Henry
Donner Steel Co.
Driver-Harris Co.

E

Electric Furnace Co.
Electrical Refractories Co.
Electro Alloys Co.
Engelhard, Charles, Inc.
Ex-Cell-O Tool & Mfg. Co.

F

Firth-Sterling Steel Co.
Ford Company, J. B.
Fuels & Furnaces

G

Ganschow Co., William
Gardner Tap & Die Co.
Gathmann Engineering Co.
General Alloys Co.
General Electric Co.
Geometric Tool Co.
Giddings & Lewis Machine Tool Co.
Gisholt Machine Co.
Goddard & Goddard Co.
Goss & De Leeuw Mach. Co.
Gould & Eberhard, Inc.
Gray Company, G. A.

H

Hagan Company, George J.
Halcomb Steel Co.
Hammond Mfg. Co.
Hanson-Whitney Mach. Co.
Heald Machine Co.
Heim Grinder Co.
Heppenstall Forge & Knife Co.
Hevi-Duty Electric Co.
Holcroft & Co.
Hoskins Mfg. Co.
Houghton & Co., E. F.

I

International Mach. Tool Co.
International Nickel Co.
Interstate Iron & Steel Co.

J

Jessop Steel Co.
Jones & Lamson Mach. Co.
Jones & Laughlin Steel Corp.

K

Kardex-Rand Co.
Kearney & Trecker Corp.
Keller Mechanical Engr. Co.
Kelly Reamer Co.
Keystone Lubricating Co.
King Machine Tool Co.
King Refractories Co.
Knight Machinery Co., W. B.

L

Landis Tool Co.
Leeds & Northrup Co.
Lehmann Machine Co.
Leitz, E., Inc.
Leland-Gifford Co.
Liberty Machine Tool Co.
Lodge & Shipley Mach. Tool Co.
Lucas Machine Tool Co.
Ludlum Steel Co.

M

Marschke Mfg. Co.
Midvale Co., The
Monarch Mach. Tool Co.
Morris Mach. Tool Co.
Morse Twist Drill & Mach. Co.

N

National Automatic Tool Co.
National Equipment Co.
National Twist Drill & Tool Co.
New Britain Machine Co.
Niles-Bement-Pond Co.
Norton Co.
Nuttall Co., R. D.

O

Oesterlein Machine Co.
Ohio Steel Foundry Co.
Oilgear Co.
O. K. Tool Co.
Olsen Testing Mach. Co., Tinius
Oliver Instrument Co.
Oxweld Acetylene Co.

P

Park Chemcial Co.
Peerless Machine Co.
Pels & Co., Henry
Pittsburgh Crucible Steel Co.
Pittsburgh Instrument & Mach. Co.
Potter & Johnston Mach. Co.
Pratt & Whitney Mfg. Co.
Production Machine Co.

R

Republic Flow Meters Co.
Rockford Machine Tool Co.
Rockford Milling Mach. Co.
Rockwell Co., Stanley P.
Rockwell Co., W. S.
Rodman Chemical Co.
Roessler & Hasslacher Chemical Co.

S

Sebastian Lathe Co.
Seneca Falls Mach. Co.
Shore Instrument & Mfg. Co.
Simonds Saw & Steel Co.
Skinner Chuck Co.
Skybryte Co.
Spencer Turbine Co.
Standard Tool Co.
Starrett Company, L. S.
Sun Oil Company
Surface Combustion Co.
Swedish Crucible Steel Co.
Swindell & Bros. Co., Wm.

T

Taylor Instrument Companies
Taylor & Fenn Co.
Thompson Grinder Co.
Thompson & Son Co., Henry G.
Timken Roller Bearing Co.

U

Union Twist Drill Co.
United Allow Steel Corp.
Universal Grinding Mach. Co.

V

Vanadium Alloys Steel Co.
V & O Press Co.

W

Walcott Lathe Co.
Walker Co., O. S.
Warner & Swasey Co., The
Westinghouse Elec. & Mfg. Co.
Wheelock, Lovejoy & Co., Inc.
Whitney Mfg. Co.
Wilmarth & Morman Co.
Wilson-Maeulen Co.

British Traffic Accidents Increase

ACCORDING to statistics compiled by the National "Safety First" Association from police returns and motor registrations, the ratio of reported traffic accidents to the number of automobiles in use is steadily increasing in Great Britain.

The following table is published with various comments, the latter mainly drawing attention to the variations in the yearly figures and percentages, but one which probably has an important bearing on the table is that relating to the increase in the accident ratio per 1000 vehicles. It is pointed out that this may be due partly to the police now getting to hear of and recording a higher proportion of street accidents and that the present-day average mileage per vehicle is much more than in the past.

TRAFFIC ACCIDENTS IN GREAT BRITAIN

	1918	1921	1922	1923	1924
Number killed..	1,144	2,091	2,222	2,435	3,019
Number injured.	13,098	36,609	42,058	53,084	64,318
Total accidents	14,242	38,700	44,280	55,519	67,337
Number of vehicles	*	860,082	962,115	1,127,590	1,312,357
Accidents per 1000 vehicles..		44.9	46.0	48.4	51.3
Fatalities per 1000 vehicles..		2.4	2.3	2.2	2.3
Vehicles per accident		22	22	20	20

*No figures available prior to 1921.

Automotive Topics Numerous at A. S. S. T. Annual Convention

Hardness testing, engineering training, tool steel buying, and future development of alloy steels among subjects discussed.

WAYS of eliminating errors in hardness testing, recent results of experimental work in quenching, argument as to whether tool steel should be bought by brand or by chemical analysis, emphasis of the need for stimulating the supply of trained technical men to keep up with industry's needs and recognition of the automotive manufacturers as the medium through which much future alloy steel development will come were among the topics of automotive interest at the convention of the American Society for Steel Treating held in Cleveland Sept. 14-18.

While many of the sessions were devoted almost entirely to discussion of the purely metallurgical side of steel treating, factors directly concerning the automotive production man appeared many times. Before the meeting was over, it had become more apparent than ever before that automotive engineers will have to pay even closer attention in the future than in the past to developments in heat treating, from a metallurgical as well as from a manufacturing viewpoint.

Bureau of Standards Work

Bureau of Standards developments and opinions, reported at the sessions on several occasions related to factors of interest to the automotive industry. In the Hardness Symposium, for example, S. N. Petrenko of the Bureau of Standards said that the elimination of errors in Brinnell testing apparatus is highly important. One of the most important sources of error, he pointed out, is the use of the wrong machine. The error of the machine, Mr. Petrenke said, should be less than the variable of the material to be tested.

Further discussion of hardness testing brought from H. P. Moore the information that three per cent is no longer used as a term of accuracy in Brinnell testing but that the A. S. T. M. calibration now speaks of the loading range as being not more or less than 15 per cent instead of considering zero the fixed factor as before.

R. C. Brumfield, Cooper Union, described a series of tests by means of which it has been possible to translate Rockwell and Brinnell hardness factors each in terms of the other. He found that for measuring purposes depth of penetration is as accurate as the diameter of the impression.

Durometer Is Described

Dr. Albert Sauveur, Harvard University, gave a description of the Durometer, a new hardness testing device. The instrument consists of a machine in which a steel ball is dropped from a determined height, is deflected from the surface of the material to be tested, and falls to a surface which registers the point of contact.

A slight overtime in quenching high-speed steel is preferred to under time said R. K. Barry, Barry Co., in his paper "Hardness and Toughness of High-Speed Steel as Affected by Heat Treatment." He also stated that it is almost impossible to harden high-speed steel so that it will reharden satisfactorily as it was hardened in the first instance.

The argument about tool steel buying came at the conclusion of the paper on "Chemical Composition of Tool Steels" by J. P. Gill, Vanadium Alloys Steel Co. Discussion arose over the maximum limits of nickel and manganese for tool steel and also over the practice of purchasing tool steel by brand rather than by analysis. A. H. Kingsbury took exception to the statement that maximum limits for nickel are 0.40 per cent and for manganese 0.30 per cent and cited examples of good brands of steel in which these limits are exceeded. Mr. Gill replied that insofar as nickel and manganese is concerned the limits given were only approximate and that Mr. Kingsbury was correct. Arguing against the practice of buying tool steel by brand, A. H. d'Arcambal contended that better results and lower manufacturing cost can be obtained through purchasing by special analysis.

The importance of the automotive industry to the alloy steel makers was emphasized by C. J. Stark, editor, *Iron Trade Review*, who pointed out that the automotive manufacturers use between 50 and 60 per cent of all the alloy steel produced. Last year, he said, a total of 3,200,000 gross tons of rolled steel was consumed by the automotive industry. Of this quantity something like 15 to 20 per cent consisted of alloys. He said also that the automotive industry offers the greatest field for future development of applications of heat treated steels.

Technical Schools Need Support

It seemed to be generally agreed by engineers at the steel treaters meeting that technical education agencies need considerable support from industry if they are to supply enough properly trained technical men to fill the needs of industry. One important idea brought out by the symposium held on this subject was that technical education in this country is at a low ebb.

A. E. White emphasized the fact that, while in Europe engineering research and study is growing rapidly, in this country, especially since the war, it has been almost at a standstill. He cited the case of one university in this country where the engineering faculty exceeds the number of enrolled students. He suggested the present plan of specialized training as a possible reason for stagnation and wondered if it would not be necessary to go back to teaching fundamentals instead.

L. W. Wallace, of the American Engineering Council, agreed with Mr. White and emphasized the importance to industry of insuring an unfailing supply of technically trained men through whose work American industries could retain, and even improve, their present position in world competition. He stressed the desirability and profitability to industry of cooperating in every possible way with schools and universities.

C. E. Skinner, Westinghouse Electric and Manufacturing Co., decried the present tendency toward specialization and said that the present day college graduate has no more fundamental education than the high school student of 20 years ago. The need was emphasized for going back to the high and prepatory schools with the educational

Automotive Production and Heat Treating

EVERY year the development of new knowledge in the field of heat treating helps to make possible better automobiles at lower cost. The past twelve months have been no exception to the general rule.

Many of these developments were outlined at the annual convention of the American Society for Steel Treating, a report of which is contained in this article.

No attempt has been made here to present details of the discussions of the various phases of metallury which took place at the meeting. The purpose of this report has been merely to summarize briefly those ideas brought out at the sessions which have a particular interest for the automotive production executive.

program in order to provide a solid foundation for future progress.

That the advantages gained by additions of nickel and cobalt in high-speed steel are associated with the heat treatment of the steel rather than with its composition was the conclusion arrived at after extensive experiments conducted by H. J. French and T. G. Digges, both of the Bureau of Standards. In a discussion of their paper Mr. Gill said that experiments he had conducted with tantalum steels showed them to be no better than other available alloy steels.

Cold Working Operations

"Investigation of the effect of cold working on a great variety of metals has shown that moderate cold working increases the endurance limit in proportion to the increase in tensile strength. Severe cold working probably increases the endurance limit proportionately less." This was the statement made by D. J. McAdam, Naval Engineering Experiment Station, in his paper "Effect of Cold-Work on Endurance and Other Properties of Metals." In reply to a question he said he had no definite theory why cold working did not increase the alternating torsion strength of nickel.

Considerable discussion was aroused over the statements made by S. C. Spaulding, Halcomb Steel Co., in his paper on the "Effect of Reheating Cold Drawn Bars." He said that tests showed cold drawn material to behave just the same in heat treating as hot rolled bars. He also stated that after cold drawing and reheating to 600 deg. F. the yield points for manganese and chrome-vanadium steels were considerably increased with a slight loss in ductility and notched bar toughness and slight increase in tensile strength. When reheated to 1000 and 1200 deg. Fahr. the yield points fall to their original figure while ductility and toughness show considerable gain over initial values.

H. T. Chandler read a paper prepared by himself and Dr. B. D. Saklatwalla, both of Vanadium Corp. of America, in which was described the application of the mathemetics of probability to determine type, source and treatment of steel for various purposes. Probability curves such as were shown with the paper, it was pointed out, are constructed from actual experiments or service data so that their use offers several advantages in selection of materials.

Dr. J. A. Matthews presented data leading to the conclusion that in oil quenching most alloy steels are given more magnetic qualities than when hardened in water quenching. His paper on "Retained Austenite" aroused considerable discussion during which W. E. Ruler, General Electric Co., said that magnetic phenomena were dependent upon principle structure as well as on the factors mentioned in the paper. Dr. Zay Jeffries cited the paper as a means of turning attention away from the erroneous conclusion that lower mechanical hardness obtained with oil than with water lead to the belief that the causes of this lower hardness were the same as with low carbon steel.

Carburizing Results

Irregularity in carburizing results can usually be traced to errors or omissions in conducting the process and steel made by ordinary methods will respond satisfactorily to cementation. These were the main points brought out by W. J. Merten, Westinghouse Electric & Mfg. Co., in his paper "Irregular Carburization—Its Causes and Preventions."

Dr. F. C. Langenberg, Watertown Arsenal, said that a simple hollow cylinder when subjected to an interior pressure does not have the stresses within its walls distributed efficiently, during the course of his paper "Effect of Cold Working on Hollow Cylinders."

H. F. French read a paper prepared by himself and O. Z. Klopsch, both of the Bureau of Standards, on "Initial Temperature and Mass Effects in Quenching." They arrived at the conclusion that in quenching steel spheres, plates or rounds the cooling velocity for any of these shapes is inversely proportional to some power of the diameter of thickness greater than one and less than two.

Either chromium molybdenum or chromium-vanadium steel can be welded, leaving a fine grained and uniform structure, according to F. T. K. Sisco and W. H. Bolton of the Army Air Service who read a paper on this subject. Their experiments have indicated that skillful welding of these metals will produce a perfect weld, although they recognize the fact that in welding seamless steel tubing with chromium-vanadium wire, such wire is harder to handle than low carbon steel wire. These investigators found also that, although these welds were uniformly strong, heat treating improves the elongation and ultimate strength. Consequently, they advise heat treatment whenever possible.

Paper on Dilatometric Method

Results obtained by the dilatometric method of heat treatment were given in a paper prepared by O. E. Harder, R. L. Dowdell and A. C. Forsyth and indicated that with the use of two new pieces of apparatus described, this method might give more economical service than that obtained with the thermocouple pyrometer. The authors believe that this method can be successfully and accurately used in hardening tools and dies and that best results should be obtained in plants where equal numbers of the same part would constitute the heat.

A paper prepared by Paul Heymans of Massachusetts Institute of Technology and read by T. H. Frost described tests carried out to determine the stress distribution around notches on impact test specimens, using the relatively new photoelastic method. The authors' conclusion was that the nature of local failure at the point of maximum stress and its propagation, hence the complete rupture of the specimen, will depend upon the general distribution and also upon the elastic properties of the material.

The American Society of Mechanical Engineers held a technical session Thursday on Machine Shop Practice which was attended by many steel treaters. H. J. Spencer, Blanchard Machine Tool Co., read a paper on modern surface grinding methods. He described a number of grinding machines, among them being one which uses a cup type of grinding wheel and which has increased the field of grinding practice to large pieces as well as reducing the cost of surface grinding small pieces. A complete description of this new machine will be presented in an early issue of *Automotive Industries.*

Bodies and Finishes Discussed

IN 476 pages of 5 in. by 8 in. type space Herbert J. Butler has placed one of the most comprehensive studies of every phase of automotive body building that has thus far been published on the subject. Every type of body is discussed, from the two-seater runabout to the large enclosed cabriolet, from the simple platform truck to the latest type of double deck bus. The particular problems that each type presents to the designing engineer are indicated and effective and approved methods for solving them are given in each instance. Not only are standard type bodies studied but all the special designs now in use are discussed. Chapters are given to the problems met with in designing windshields, seat fittings, doors, windows, and similar objects. Special types of motor bodies, such as taxicabs, hearses, fire apparatus, etc., are discussed in detail.

Materials used in body construction are identified according to their characteristics and use in body work. Separate chapters are devoted to sheet metal working, body mounting, the design of private body work and trimming. The book contains 50 working drawings, forming a very valuable collection of modern designs in private, commercial and passenger body work. In addition to these there are 245 illustrations depicting various body styles, construction details, or methods. Each subject is treated in detail so that the book can serve as a practical "how to do it" book for body designers. It is based largely on British practice which, while somewhat different from that used in America, is sufficiently advanced to offer some very interesting and valuable ideas to American designers seeking for new designs, or improvements to old ones.

This book, which is titled Motor Bodywork, is published in England by W. R. Howell & Co., with American offices at 32 Pearl Street, New York. The price is $16.

Another excellent book recently published deals with the finishing of motor car bodies. It is entitled Motor Car and Coach Painting and is by Charles E. Oliver.

This book is a very complete work on painting and finishing and includes every subject from the preparation of surfaces before painting to estimating costs of various jobs. There are 48 chapters and each one takes up a single subject such as priming, preparation of old painted surfaces, application of various finishes, japanning and varnishing, painting for mass production, paint shop equipment, etc., and discusses it in great detail so that there is no possible chance for misunderstanding just what methods and equipment the author recommends for the work. Wherever it was considered necessary or advantageous to clarify the text specially posed photographs are inserted illustrating the particular equipment or method under discussion. Altogether it is a very valuable and wholly practical work on finishing methods in use both in this country and in Europe. It contains 244 pages of about 5 in. by 8 in. type space, 41 full page illustrations, and sells for $8. The American agents for the publishers are W. R. Howell & Co., 32 Pearl Street, New York.

Practices Adapted by A.S.S.T.

THE following recommended practice for heat-treating high tungsten tool steel, also known as high speed steel, was adopted recently by the American Society for Steel Treating:

Operations—
Heating for annealing.
Cooling.
Heating for hardening: (*a*) Preheating; (*b*) Heating for quenching.
Quenching.
Tempering for secondary hardness.

Heating for Annealing—Heat slowly and uniformly to a temperature of 1600 deg. Fahr. and hold for complete adjustment and for complete uniformity of grain.

Cooling—Cool in furnace, infusorial earth, mica, lime or any medium that will permit of uniform slow cooling.

Heating for Hardening—(*a*) Preheating—Heat slowly and uniformly to 1500 deg. Fahr. in a furnace of sufficient size.

(*b*) Heating for Quenching—Transfer preheated steel to a high temperature furnace that is maintained at a temperature of 2250 to 2400 deg. Fahr., depending on the type of tools being hardened.

In order to obtain the most satisfactory "red hardness" conditions, the steel should be brought rapidly to the higher temperature; but in many cases the character of the cutting edges of certain form tools, such as milling cutters, threading tools, etc., makes it inadvisable to use the higher temperatures owing to destruction of the delicate edges through blistering, pitting, etc. It is therefore usual to use the higher temperatures for tools such as rough lathe tools, while the finer class of tools is hardened at the lower temperatures.

AN investigation of the effect of keyways on the strength of shafts has been made by H. J. Gough of the National Physical Laboratory, England. The main object was to determine the relative limiting ranges of torque under reversals of load for a solid shaft, a shaft with a standard keyway, and a shaft with a keyway of equal depth and half the width of a standard keyway. The limiting ranges of torque were determined by endurance tests. Two materials were employed in the tests, Armco iron—as representing materials of great ductility—and 0.65 per cent C. steel, as typical of harder metals. Endurance tests were also made upon a keyed drive in which the torque was transmitted through a shaft via a key to a keyed member. The elastic stiffness and strength of each type of shaft under statical torsional straining have also been determined. These results have been compared with those calculated from empirical formulæ derived from soap film experiments by Dr. A. A. Griffith.

Under reversed torsional stresses the limiting ranges of torque for shafts with full width and half width keyways were found to be identical for any one material. The reduction in strength due to the presence of the keyway amounted to 21 per cent and 12 per cent for 0.65 per cent C. steel and Armco iron respectively. In the keyed shaft—of Armco iron—a total reduction of 33 per cent was observed. The effect of the presence of the keyway was to reduce the elastic stiffness by 6 per cent and 10 per cent, respectively, for shafts containing the narrow and wide keyways. The reduction in elastic strength for each type of keyway had the same value of 23 per cent. Agreement was found in comparing these results with those predicted by the formulæ of Griffith, the maximum divergence being 4.7 per cent.

A. H. Bartsch

Alfred Reeves

M. L. Heminway

SPEAKERS at the annual conference of Chilton Class Journal Company salesmen in Philadelphia last week. Mr. Bartsch is general sales manager of the American Bosch Magneto Corp., Mr. Reeves is general manager of the National Automobile Chamber of Commerce, and Mr. Heminway is general manager of the Motor and Accessory Manufacturers Association

"Know Your Stuff," Convention Key-note; Bartsch, Heminway and Reeves Address Salesmen

Advertising representatives of Chilton Class Journal Company hold Annual Conference at Philadelphia. Service to industry emphasized.

AT the annual sales conference of the Chilton Class Journal Company, held at the publishing headquarters, Philadelphia, during the past week and attended by the company's advertising salesmen from all parts of the country, a great deal of emphasis was given a key-note slogan, "Know Your Stuff," which emanated from A. H. Bartsch, general sales manager of the American Bosch Magneto Corp., Springfield, Mass.

Mr. Bartsch was one of the speakers at the conference and also at the banquet held at the Union League on Friday evening, as were Alfred Reeves, general manager of the National Automobile Chamber of Commerce, and M. L. Heminway, general manager of the Motor and Accessory Manufacturers' Association.

Mr. Bartsch stated that a new note has been sounded in the merchandising of automotive products; that during an era, now passed into history, the salesman who had a good fund of funny stories, "personality," and an acquaintance in the trade could get along pretty well—or at least in many cases did get along pretty well.

But today the salesman who tries to "get by" without a specific knowledge of his merchandise, a definite knowledge of his competitive market, and a thorough conception of the customer's needs, is a failure—both to himself and the company he represents.

Mr. Bartsch made it plain that the superficial salesman is rapidly passing from this industry and trade. He said that another negative brand, the man who is forever discussing reasons why "it can't be done," is also speeding toward the exit turnstiles.

"The salesman of today and of tomorrow," said he, "is the man who, when he enters your office, has something really constructive to say—and says it. Such men are welcomed by the executive who sits in the buyer's chair. The inefficient salesman who, perforce, receives scant consideration at the hands of such a buyer may tell you that the buyer is hard boiled and crusty. Well, he has got to be when empty handed salesmen attempt to monopolize his productive time."

Conference Opened by President

C. A. Musselman, president of the Chilton Class Journal Company, upon opening the conference, addressed the salesmen upon general subjects relating to policy, etc. Among other things he said:

"Now, for the first time since the merger of the Chilton and Class Journal companies, we find out reorganization practically completed and the decks cleared for action. This merger has been as beneficial to the industry as it has been to ourselves.

"Our internal problems have been minimized and should find us turning outward toward sales possibilities instead of inward toward problems of administration.

"This meeting is the first under the new order, and I

hope the knowledge of our present ability to go forward will be as inspiring to you men in the field as it is to us who have been making plans for this turn of the tide.

"There have been many changes, some of a radical nature, since the two publishing interests came together, but I believe the rank and file of the organization are fully convinced that these changes were not only necessary but inevitable.

"It is true that an individual or a corporation cannot go forward if it remains in a rut. Ruts create resistance and when riding in them the slower ones ahead cannot be passed. Let us all take heart in an appreciation of the fact that we are out of the rut.

Great Changes Have Occurred

"Great changes have occurred in the manufacturing and merchandising of automobiles and automotive products. Comparable changes have been made, and are being made, in the publishing service we are rendering the automotive manufacturers.

"You men who represent us in the various territories must be constantly mindful of the new order of things. Your contact with our clients and prospective clients, must be on the basis of serving those contacts faithfully, honestly and well, with a group of papers which specifically function to specific needs—whether those needs be manufacturing, wholesaling or retailing the products of the greatest and most interesting of any industry the world has ever known."

At the conclusion of the convention, on Saturday at noon, Mr. Musselman stated:

"A company with ample finances, with the leading publications, and the right men directing it, such as we find on the United Publishers Corporation board of directors, is one so well entrenched that it is unassailable so long as the man-power is of the quality we have in this organization.

"You on the firing line are more fortunate than many men I know of on other sales staffs, because you have as your sales director a man who understands selling, a man who understands human feelings, a man who is tolerant and helpful, and can lead by example."

At the conclusion of his welcome to the staff, Mr. Musselman turned the conduct of the sessions over to J. S. Hildreth, vice-president and sales director.

Alfred Reeves, New York, general manager of the National Automobile Chamber of Commerce, in his address said:

"Do not let any one minimize the importance of trade papers in the automotive industry. This has been a big, fast-moving and fast-growing industry, but it has been guided very largely by the trade papers.

Surveys Have Been Helpful

"The surveys which you have made in the past have been very helpful. Information is valuable, and the kind we can always depend upon getting from you is especially valuable to those executives throughout the industry who are looking ahead and planning for the future.

"You men in the advertising end of this business are big factors in the industry. Carrying news of high value to the industry, the trade papers are of great service and I do not know of any industry in the country where they have been of greater service than in the automotive field.

"It is axiomatic that where you find good trade papers you also find a good, successful, co-operative industry. We want good, independent thinking papers which will not hesitate to constructively criticize and to comment on the evils of the industry. I am opposed to 'association organs.'

"There are two things a successful automotive dealer must do: First, read his daily newspaper every day; and, second, read a good trade paper regularly.

"There is room for improvement in automobile advertising. In the class of certain advertising that has come out within the last thirty days you could take one firm name out of a piece of copy, put in another name—and the argument would apply with equal force in either case.

"We have a great big field because the motor car is an article of universal desire. It is going to increase in numbers and in use. We are making thirty-one miles of automobiles every working day of the year.

"Bankers tell me that the automobile business has been the most wonderfully conducted of any business in this country. especially during the first six months of this year. A good measure of credit for this desirable condition of affairs belongs to the trade papers. During this period the dealer made money, the industry made money, there were no price cuts, and no new model announcements until after the first of July, which is as it should be.

"Automobile financing is the best of any being done in this country. Sixty-five per cent of all cars manufactured are sold on time, but the loss to the finance companies is less than two-fifths of one per cent.

"The automobile industry has three normal problems: Engineering, that is taken care of; Production, which has been mastered; and third, Sales Advertising and Distribution.

"In this third problem you, and the publications you represent, can continue to be highly helpful.

"I want to congratulate you on your magnificent plant and your organization. A big organization has advantages which a small one can never have. Hence your advantages are big.

Team Work to Get Results

"If you are going to get results you must have team work. Many times you, as individuals, are obliged to do things you would rather not do, but those things are necessary parts of successful team work. Keep up the Chilton Class Journal team work."

The next speaker was General Manager M. L. Heminway of the Motor & Accessory Manufacturers' Association, who evidenced a considerable degree of optimism for the future of the industry and, like Mr. Reeves, stressed the important part taken by the principal trade papers in making this the greatest and fastest moving industry of all time.

William M. Webster, commissioner of the Automotive Equipment Association, was scheduled to speak but could not be present owing to a death in his family.

Speakers at the banquet, in addition to Messrs. Reeves, Heminway, Musselman and Hildreth, were Charles G. Phillips, New York, president, and A. C. Pearson, New York, vice-president of the United Publishers Corporation, of which the Chilton Class Journal Company is a component part.

Mr. Phillips spoke on the subject of "Empty Hands" and laid particular stress upon the mental and other equipment necessary for the present day advertising salesman if he is to be successful.

Mr. Pearson outlined to his nearly one hundred auditors the incomporable advantages they possess in having access to the industrial and merchandising laboratories of the United Publishers Corporation in obtaining authoritative market analysis and trade surveys, not only automotive but those which deal with other United Publishers Corporation units, including iron and steel, hardware, textiles, shoes, leather, etc. He pointed out that these broad research facilities are available to any Chilton Class Journal Company client who can use them.

At the sales conference: Advertising representatives of the Chilton Class Journal Company from all parts of the United States attended the annual meeting in Philadeljhia. This is a group picture taken during the session

He further stated that the U. P. C. is the largest business paper publishing company in the world, and that in the publishing of its periodicals the printing was done upon paper made in the U. P. C. paper mills, from wood grown in the corporation's forests, that the company owns its own engraving and printing plants and, except for the printing inks used, is entirely independent of outside sources of supply.

During the sessions of the sales conference, various of the Chilton Class Journal executives and department heads furnished convincing evidence that the automotive industry and trade are in better condition today than ever before, that 1926 will prove bigger than the current year, and that the Chilton Class Journal publications are in stronger position than at any time in automotive history to render both industry and trade an improved editorial service, with circulation distributions virtually blanketing the fields covered.

Parts Sales Discussed by Electric Association

DISTRIBUTION of service parts, automobile head lighting and motorcoach electrical equipment were among the major topics discussed at the ninth annual convention of the Automotive Electric Association held at Eaglesmere, Pa., Sept. 14 to 17.

The discussion parts sales covered a particularly broad field as the board of governors of the Automotive Electric Association was present as the guest of the manufacturers and consequently the viewpoint of the wholesaler was adequately presented. Judging from the trend of opinion at the meeting there will be a greater concentration of effort in the future on the expansion of wholesaling and retailing facilities as it is recognized that the 2500 authorized service stations, of which no one maker has more than 1000, are not sufficient to take care of service on the 18,000,000 registered motor vehicles.

Final action on the specification covering motorcoach electrical equipment was held up pending the possible addition of a 600 watt generator to the three small units already adopted as standard. The proposed new unit will probably be the same as the 450-watt size except that it will develop its rated output 120 r.p.m. per bus mile per hour instead of 80. It was pointed out that the rated outputs in this specification are at 1200 r.p.m. and that longer outputs are obtained at higher speeds. Minor changes were made in the specification covering battery ignition test equipment and procedure.

The committee also has under preparation a standard specification covering bus wiring.

The association is taking action through its legal and patents committee to see that members get desired tariff protection from competition of foreign makers of automotive electrical equipment. It was stated that it has been customary to classify such equipment under the head of "Manufactured Goods Made Principally of Metal" which carries a 40 per cent rate, but that a new decision had been rendered which indicated the possibility of this class of goods being admitted as automobile parts which are taxed but 25 per cent.

In order to assist its members in meeting the requirements of the various State laws, the association is undertaking the distribution of information as to what constitutes doing business in each State and also to keep the manufacturers informed as to developments in this direction through a bulletin service.

Work on the standard course of instruction for automotive electricians is nearing completion and it is expected that a number of the leading schools will conform to its requirements. Such institutions as do conform to the association's program will be permitted to advertise the fact and graduates of their courses who attain a rating of 85 per cent or more and who have had a specified amount of practical shop experience will be granted certificates as evidence of their proficiency.

In his address summarizing the work of the association, president A. D. T. Libby placed particular emphasis on the work of the service and standards committees. The former group with the assistance of the advertising committee, has published the booklet entitled "Profitable Electrical Service" which has been widely distributed in the electrical field and, in addition, will shortly publish a booklet on electrical service for the car dealer. The committee is also working on a standard warranty report form to simplify service station paper work. It has promoted the use of flat rates and has assisted in the preparation of the standard mechanics training course.

Preparation of specifications covering motorcoach electrical equipment and of battery ignition test procedure are among the outstanding accomplishments of the standards committee. This committee has also published the A. E. A. handbook of electrical equipment standards which has been widely distributed among motor vehicle manufacturers and has assisted in the establishment of the new motorcoach battery specifications.